

KING COUNTY INTERNATIONAL AIRPORT

STORM DRAINAGE STUDY

JULY 1995

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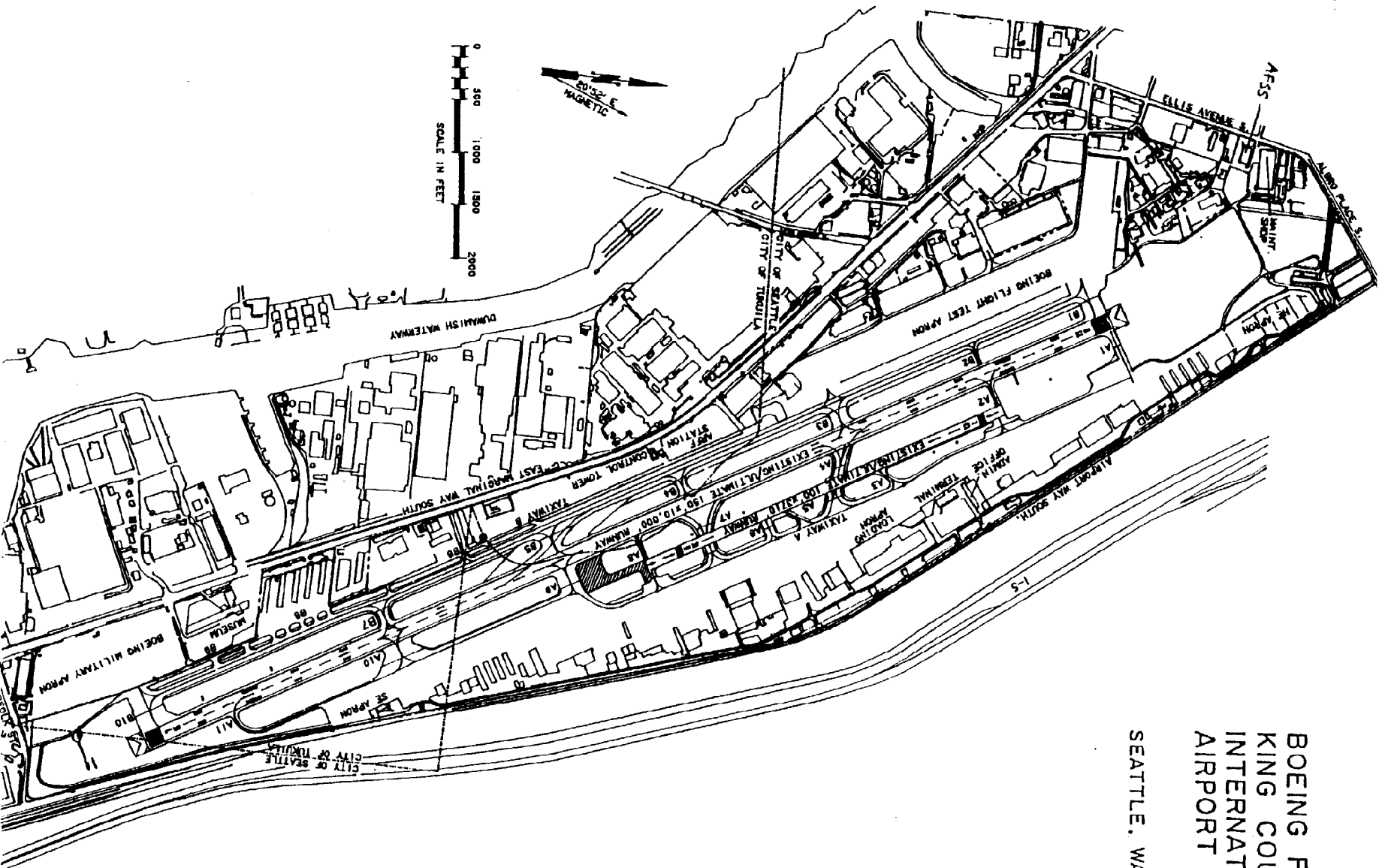
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BOEING FIELD/ KING COUNTY INTERNATIONAL AIRPORT

SEATTLE, WASHINGTON



1 - STORMWATER REGULATIONS SUMMARY

Summary

This task develops a Stormwater Regulations Summary which summarizes the local, state and federal laws and regulations which pertain to storm drainage, water quality and 100 year flood plain criteria to be used for the hydrologic and hydraulic evaluation of the Airport's existing storm drainage system. The primary documents for this summary consist of the National Pollution Discharge Elimination System and State Waste Discharge Baseline General Permit for Stormwater Discharges Associated with Industrial Activities (NPDES/BGP), The Washington State Department of Ecology's Stormwater Management Manual for the Puget Sound Basin (DOE/SMMPSB) and the King County Surface Water Design Manual (KCSWDM) will be the primary documents for this summary.

NPDES/BGP

The United States Environmental Protection Agency (USEPA) has designated the Washington State Department of Ecology (Ecology) as the agency to implement the USEPA requirements for industrial storm water permits in Washington State. The Ecology storm water pollution control program is based, in part, on the federal regulations of Title 40 of the Code of Federal Regulations, parts 122, 123, and 124 and the implementation of section 402(p) of the Federal Clean Water Act. The goal of these federal regulations are to eliminate surface water quality standards violations caused by storm water and to reduce or eliminate the pollution of storm water from municipal and industrial point sources by requiring the implementation of technology based Storm Water Pollution Control Plans (SWPPP).

Under the authority of Chapter 90.48 of the Revised Code of Washington (RCW), Ecology has expanded the scope of its storm water program to exceed the federal government's goals. Ecology's program requires eventual compliance with ground water and sediment management standards for those facilities that are required to obtain an NPDES permit for a storm water discharge. This permit is referred to as the Baseline General Permit (BGP).

The contents of the SWPPP, in general, comply with the Best Management Practices (BMPs) as set forth by Ecology's Storm Water Management Manual for the Puget Sound Basin. Enclosed in Appendix A are the Permit and Fact Sheet for the NPDES/BGP.

DOE/SMMP SB

The Washington State Department of Ecology's Stormwater Management Manual for the Puget Sound Basin regulates stormwater runoff with the use of 11 Minimum Requirements when more than 5,000 square feet or 1 acre of land disturbing activities is proposed on a parcel of land. A summary of these Minimum Requirements are as follows:

- #1 Erosion and Sediment Control
An Erosion and Sediment Control Plan shall be prepared which develops a plan which prevents sediment laden waters from leaving the site.
- #2 Preservation of Natural Drainage Systems
Stormwater shall discharge at the natural location to the maximum extent practical.
- #3 Source Control of Pollution
Source Control BMPs shall be provided which prevent stormwater from coming in contact with pollutants shall be applied to the maximum extent practical.
- #4 Runoff Treatment BMPs
Runoff Treatment BMPs shall be provided which reduce pollutant loads and concentrations in stormwater runoff using physical, biological and chemical removal mechanisms. Runoff treatment is intended to treat up to 91 % of the annual stormwater runoff volume. Coalescing Plate oil/water separators provide an effective means of water quality treatment and are also a recommendation of King County Special Requirement #6. These measures would be required if the Airport decided to redevelop a portion of their property.
- #5 Streambank Erosion Control
This reduces streambank erosion downstream of the site. This is not applicable to the Airport because discharge is directly to the Duwamish Waterway, which is classified as a major River and does not require detention (the proposed runoff rate does not need to match that of the predeveloped flow rate).
- #6 Wetlands
Additional runoff treatment BMPs must be provided if site stormwater discharges to a wetland. There are no wetlands within the Airport property.

- #7 Water Quality Sensitive Areas
Additional water quality treatment BMPs may be required if determined by a local government if the site discharges to a sensitive area as determined by SEPA or a drainage basin plan. The most recent drainage study of the Duwamish Waterway was prepared the surface Water Management Division of King County in June 1987. It makes no statement in regards to the King County Airport.
- #8 Off-Site Analysis and Mitigations
A 1/4 mile downstream analysis of off-site water quality shall be performed.
- #9 Basin Planning
If an adopted or implemented basin plan has been approved by local jurisdiction and has requirements which exceed these minimum requirements, then the basin plan shall be adhered to. An adopted drainage basin plan for the Duwamish Waterway does not currently exist.
- #10 Operation and Maintenance
An operation and maintenance schedule shall be prepared for all proposed stormwater control facilities.
- #11 Financial Liability
Performance bonding or other appropriate financial instruments shall be required for all projects to ensure compliance with these standards.

KCSWDM

The King County Surface Water Design Manual consists of 7 Core Requirements and 12 Special Requirements.

CORE REQUIREMENTS

- #1 Discharge at the Natural Location
The discharge from a proposed project site must occur at the natural location.
- #2 Off-Site Analysis
All proposed projects must identify the upstream tributary drainage area and perform a downstream analysis. Levels of analysis required depend on the problems identified or predicted. At a minimum, Level 1 analysis must be submitted with the initial permit application.

#3 Runoff Control

Proposed projects must provide runoff controls to limit the developed conditions peak rates of runoff to the pre-development peak rates for specific design storm events based on the proposed project site existing runoff conditions, and install biofiltration measures. Detention is not required because of direct discharge to the Duwamish Waterway.

#4 Conveyance System

All conveyance systems for proposed projects must be analyzed, designed and constructed for existing tributary off-site runoff and developed on-site runoff from the proposed project. This core requirement is the main focus of this study. As stated in the KCSWDM, the pipe system shall be designed to contain the 25 year design storm and provide a minimum of 0.5 feet of freeboard between the hydraulic grade line and the top of the structure (catch basin or manhole). The 100 year backwater analysis shall be determined and show that it does not overtop the crown of a roadway or flood any portion of a building.

#5 Erosion/Sedimentation Control Plan

All engineering plans for proposed projects that propose to construct new, or modify existing drainage facilities, must include a plan to install measures to control erosion and sedimentation during construction and to permanently stabilize soil exposed during construction.

#6 Maintenance and Operation

Maintenance of all drainage facilities constructed or modified by proposed project is the responsibility of the property owner.

#7 Bonds and Liability

All drainage facilities for proposed projects must be constructed in conformance with the bond and liability requirements of King County Code 9.04.100

SPECIAL REQUIREMENTS

#1 Critical Drainage Areas

King County Code 9.04.060 provides the authority to establish critical drainage areas within which any proposed project must comply with the special requirements. The Airport is not within a critical drainage basin.

#2 Compliance with an Existing Master Drainage Plan

Master Drainage Plans (MDP's) are comprehensive drainage system plans which are prepared for Master Planned Developments (MPD's) or other large proposed projects as described below in Special Requirement #3. These plans require more comprehensive hydrologic, geologic, and environmental analysis than a drainage plan normally required for a smaller project. The Airport is not within a master drainage plan.

#3 Conditions requiring a Master Drainage Plan

Is a Master Planned Development (MPD) as described in an adopted Community Plan or is a subdivision of Planned Unit Development (PUD) that will eventually have more than 100 single-family residential lots and encompasses a contiguous drainage subbasin of more than 200 acres or is a commercial development or Planned Unit Development that will eventually construct more than 50 acres of impervious surface or will clear an area of more than 500 acres within a contiguous drainage sub-basin. This does not apply to the Airport.

#4 Adopted Basin or Community Plans

The King County Council adopts Basin and Community Plans to provide for the comprehensive assessment of resources and the needs to accommodate growth, while controlling adverse impacts to the environment. Following collection of hydrologic, physiographic, and land use data and analysis by computer modeling, a final Basin Plan may recommend land use, regional capital projects, and special drainage requirements for proposed projects within the area covered by the Basin Plan. Community plans may also contain some special drainage requirements through "P-suffix" zoning designations.

#5 Special Water Quality Controls

If any threshold discharge area of the proposed project contains more than 1 acre of new impervious surface that will be subject to vehicular use or storage of chemicals and proposes direct discharge of runoff to a regional facility, receiving water, lake, wetland, or closed depression without on-site peak rate runoff control or proposes discharge of runoff through overland flow or on-site infiltration into a Class 1 or 2 stream (Duwamish River is a Class 1), or Class 1 wetland, within one mile radius downstream from the project site. Then the threshold discharge area shall have a wetpond meeting the standards described below employed (in addition to peak rate control requirements) to treat a project's runoff prior to discharge from the site. A wetvault or water quality swale, may be used when a wetpond is not feasible because of physical site constraints or impacts to sensitive areas.

#6 Coalescing Plate Oil/Water Separators

If a proposed project will construct more than 5 acres of impervious surface in any threshold discharge area that will be subject to: petroleum storage or transfer; OR high vehicular use (more than 2,500 vehicle trips per day); OR heavy equipment use, storage or maintenance. Then a coalescing plate, or equivalent, oil/water separator shall be employed in the threshold discharge area to treat the project's runoff prior to treatment, by a wetpond, wetvault, or water quality swale, and/or discharge from the project site (including infiltration).

#7 Closed Depressions

Closed depressions are low-lying areas which have no, or such a limited, surface outlet that in most storm events the area acts as a retention basin, holding water for infiltration into the ground or evaporation into the air. By their nature many closed depressions may contain wetlands which will require projects to meet the requirements of the Sensitive Areas Ordinance and Rules. There are no closed depressions within the Airport property.

#8 Use of Lakes, Wetlands or Closed Depressions for Runoff Control

None.

#9 Delineation of the 100 year Floodplain

The Airport is not within the 100 year floodplain of the Duwamish River.

#10 Flood Protection Facilities for Type 1 and Type 2 Streams

Not Applicable

#11 Geotechnical Analysis and Report

Not Applicable.

#12 Soils Analysis and Report

Not Applicable.

2 - ANALYSIS PHASE

Summary

The King County International Airport's drainage system has been analyzed for the 25 and 100 year storm events. The method of analysis used was the Santa Barbara Urban Hydrograph Method. This method is based on a unit hyetograph, which is then multiplied by the precipitation value for a given storm event. The precipitation values for the 6 month storm event is 0.67 inches, the 25 year storm event is 3.40 inches and the 100 year storm event is 4.05 inches. The computer model used for the 25 and 100 year analysis is the Stormwater Management Model by XP Software. The computer program used for determining 6 month water quality flows is the Waterworks program by Engenious Systems.

The total area of the Airport is comprised of 615 acres. There is approximately 57 acres of this area at the very south end of the Airport which were not included in the study because they have separate drainage systems which are not a part of the one main gravity system and the two pump stations tributary areas. The study area of the Airport's one gravity and two pump station drainage systems consists of 558 acres and the 26 acres of off site areas entering the Airport's primary drainage systems. The existing system is comprised of 3 outfalls to the Duwamish River, 2 pump stations (the south pump station has six pumps and the north pump station has four pumps), 9 oil/water separators and a network of 315 manholes or catch basins and 333 storm drain pipes. Only pipes which have a 12 inch diameter and larger are analyzed. The total length of the existing drainage system is approximately 15 miles.

The main purpose of the study is to determine the conveyance capacity for the 25 year storm event and the backwater analysis for the 100 year storm event. These two storm events were selected per the KCSWDM Core Requirement #4 - Conveyance System. In addition, the adequacy of the pump stations and the effectiveness of the oil/water separation facilities will also be analyzed. The goal of improving stormwater quality beyond that of oil/water separators needs to be further studied to achieve the long term needs of the Airport.

2.1 - Computer Modeling Analysis

A - Existing 25 Year Conveyance

The results of the 25 year conveyance analysis show that 29 existing manholes/catch basins (9 % of the total) have water surface elevations which exceed their rim elevations, which means they are flooded or overtopping. This means that in a general sense, there are some existing pipes that are undersized to carry the 25 year flows. The two pump stations have the capacity to pump the 25 year flows. The south pump station consists of six 30 horsepower pumps with a pumping rate of 6,000 gpm or 13.4 cfs. The 25 year peak flow from the south pump station is 52.8 cfs, which is pumping at 67 % of its total capacity of

80.4 cfs. The north pump station consists of three 30 horsepower pumps with a pumping rate of 6,000 gpm or 13.3 cfs and one 50 horsepower pump with a pumping rate of 9,000 gpm or 20.1 cfs. The 25 year peak flow from the north pump station is 48.3 cfs, which is pumping at 80 % of its total capacity of 60.3 cfs. The results of this model can be found in Appendix B of the appendices. The two pump stations have the capacity to meet future redevelopment needs to the limit of their excess capacities, which are 27.2 cfs for the south pump station and 11.9 cfs for the north pump station.

B - Existing 100 Year Backwater Analysis

The results of the 100 year conveyance analysis show that 70 drainage manholes/catch basins (22 % of the total) have water surface elevations which exceed their rim elevations. The pumping capacity of the two pump stations is sufficient to discharge the 100 year peak storm events. The 100 year peak flow from the south pump station is 64.5 cfs, which is pumping at 81 % of its total capacity of 80.0 cfs. The 100 year peak flow from the north pump station is 58.9 cfs, which is pumping at 98 % of its total capacity of 60.2 cfs. The south pump station has the capacity to have one pump out of operation for repairs for the 100 year event while the north pump station does not. The results of this model can be found in Appendix C of the appendices.

2.2 - Operation & Maintenance Evaluation

Proper maintenance of the existing drainage system is fairly important in order for the system to operate correctly, especially in regards to the coalescing oil/water separators and the water quality they are intended to provide.

The following operation and maintenance recommendations are a summary of the recommendations from Appendix A - Maintenance Requirements for Privately Maintained Drainage Facilities of the KCSWDM.

Catch basins grates should be cleaned off when more than 0.5 cubic feet or 10 percent of the grate area are blocked by trash, debris or vegetation. Catch basins sumps should be cleaned out when more than 1 cubic foot of sediment or 1/3 the depth (distance from the bottom of the basin and the lowest pipe invert) contain sediment.

Storm drain pipes should be cleaned out when more than 20 percent of the diameter is blocked by trash or debris or when vegetation impedes the free movement of water. Pipes should be repaired or replaced when more than 50 percent of any part of the pipe has deteriorated or a dent has caused a decrease in cross sectional area by 20 percent.

Oil/Water Separator's should be maintained twice a year. This would consist of having any sediments removed from the structures sump volume. All coalescing plates should be steam cleaned and rinsed so that no residue enters back into the drainage system. These sediments and residue should be properly disposed of as these materials are typically considered as hazardous waste. The plates should also be inspected to insure that they are

functioning properly and have not been damaged or contain blockages. If the Airport does not have the resources to perform the maintenance of separators, these services can be contracted out by companies expert in this type of work.

Current maintenance procedures consist of on a seasonal basis in the months of August and September inspecting the storm drain pipes and catch basins. The pipes are cleaned of any debris or obstructions and the catch basins are vactored of sediment accumulation. The oil/water separators are pumped out, removing sediments and oil residue. If any pumps or pump motors require overhauling, it is done at this time.

Quarterly and preseasonal inspections consist of checking catch basins for any debris accumulation and the pump stations are inspected to insure that all systems are fully functional.

The Airport has 24 hour police and fire personnel which are trained to respond to any accidental spill events.

3 - RECOMMENDATION PHASE

Summary

Three areas of the storm drainage network have been selected for improvements to increase the capacity in these areas. Constructing additional storm drain pipes in these three areas would also decrease the 100 year flood water levels. The first area is east of the Terminal Building along Perimeter Road and has a 100 year maximum flooding depth of 1.37 feet, the second area is between the north half of the two runways and has a 100 year maximum flooding depth of 0.85 feet and the third area is approximately 100 feet north of the north end of the runways and has a 100 year maximum flooding depth of 1.31 feet.

Improvements to the pump stations are also recommended for improvements, primarily due to the age and maintenance expense on the existing pumps. This would consist of the replacement of the pumps, pump motors, controls and the float level detection systems.

There are seven existing baffle type oil/water separators and two existing coalescing type oil/water separators which were analyzed to determine the 6 month water quality stormwater flows. The 6 month storm is selected by the DOE because it represents 91 % of the annual rainfall in the Puget Sound region. These separators are primarily located along the south and eastern part of the Airport. The baffle type separators only provide oil/water separation and do not provide any water quality treatment, therefore it is recommended that they be replaced with coalescing plates which provide water quality treatment.

Other methods of water quality treatment were considered, such as biofiltration swales. Biofiltration swales would consist of a grass lined ditch 200 feet in length and at the depth of the existing storm drain system, which could be between 5 and 10 feet deep. At this depth the biofiltration swales would present a safety hazard to airplane traffic and therefore were not considered a viable option.

The large grass areas that are located between the middle of the runways act as what is known as vegetative biofiltration swales or filter strips and provide an effective form of water quality treatment. These grass areas provide treatment to all the impervious surfaces tributary to them.

The western and northern portion of the Airport, where no facilities exist, is also recommended for water quality treatment with the use of eight coalescing plate oil/water separators. This area is between E. Marginal Way and the west runway.

3.1 - Improvements

The recommended improvements to the storm drainage system in the first area consists of installing 130 feet of 12" diameter pipe, 2610 feet of 18" diameter pipe and 13 catch basins. The second area consists of installing 245 feet of 12" diameter pipe, 450 feet of

18" diameter pipe, 690 feet of 24" diameter pipe, 4 catch basins, 3 manholes and a diversion structure. The third area consists of 860 feet of 18" diameter pipe, 395 of 24" diameter pipe, 3 catch basins and 5 manholes. Constructing these improvements will increase capacity and dramatically decrease the level and duration of stormwater ponding. The schematic design of these improvements can be found on sheets 6, 7 and 8 of the schematic design plans in appendix G.

The recommended improvements to the two pump stations consists of the replacement of the pump motors, controls and the float level detection system. These improvements are recommended for several reasons. The pump stations were constructed in the 1940's and are nearing their original service life of approximately 50 years. Due to their age they are relatively expensive to maintain and rebuild when requiring maintenance.

Constant speed pump motors are recommended over variable speed pump motors because of the large volume of stormwater that the pump is required to lift and are more expensive to purchase, operate and maintain. Also, new pump motors would be more efficient and would reduce energy costs. Although it difficult to quantify energy savings because it is not known what the efficiency ratings are for the existing pumps, savings could realistically be expected to be in the 10 to 20 % range.

New instrumentation and programable level controls will increase reliability and evenly distribute motor wear and operating durations. Options of new controls consists of float switches, a bubbler system and an electronic transducer system with milltronic program-mable level controls. The station should also be modified to accept an emergency power source in the event of an electrical power failure.

Although spill events are relatively rare, the Airport needs to be prepared in the event one occurs, consequently the recommendation regarding the oil/water separators consists of replacing seven existing baffle type separators and installing eight additional coalescing type oil/water separators along the western and northern portion of the Airport. These type of separators provide an effective means of spill containment due to their large size and down turned elbow outlets which prevent oil or fuels from escaping the separator. These were selected due to site constraints of area and elevations, which other means of water quality treatment require. The size of the separator is dependent on the 6 month flows as determined from their hydrographs. These consists of 1 with the dimensions of 4'-8" wide, 7'-0" long and 7'-0" deep, 3 with the dimensions of 5'-8" wide, 11'-2" long and 7'-2" deep, 7 with the dimensions of 6'-8" wide, 12'-8" long and 8'-0" deep and 4 with the dimensions of 9'-11" wide, 19'-11" long and 11'-1" deep. These proposed facilities can be found on the schematic design plans in appendix G.

3.2 - Implementation Plan

The cost of improvements have been estimated according to each design element. See the table on the following page.

KING COUNTY INTERNATIONAL AIRPORT IMPLEMENTATION PLAN

7/12/95

ITEM	UNIT	QUANTITY	UNIT PRICE	COST
STORM DRAINAGE SYSTEM				
ASPHALT CLASS B	C.Y.	86	\$70	\$6,020
CRUSHED ROCK	C.Y.	121	\$30	\$3,630
CONCRETE CLASS II	C.Y.	183	\$90	\$16,470
12 INCH PIPE	L.F.	375	\$30	\$11,250
18 INCH PIPE	L.F.	3920	\$40	\$156,800
24 INCH PIPE	L.F.	1085	\$55	\$59,675
CATCH BASIN TYPE 1	EACH	2	\$1,400	\$2,800
CATCH BASIN TYPE 2	EACH	18	\$2,000	\$36,000
MANHOLE TYPE 3 - 48" DIA.	EACH	7	\$2,000	\$14,000
MANHOLE TYPE 3 - 60" DIA.	EACH	1	\$2,600	\$2,600
MANHOLE TYPE 3 - 48" DIA. W/ WIER STRUCTURE	EACH	1	\$4,000	\$4,000
TOTAL STORM DRAINAGE SYSTEM COST				\$313,245

ITEM	UNIT	QUANTITY	UNIT PRICE	COST
COALESCING PLATE OIL/WATER SEPARATORS				
200 GPM CAPACITY	EACH	1	\$10,000	\$10,000
300 GPM CAPACITY	EACH	3	\$15,000	\$45,000
400 GPM CAPACITY	EACH	2	\$22,500	\$45,000
600 GPM CAPACITY	EACH	5	\$27,000	\$135,000
800 GPM CAPACITY	EACH	2	\$45,000	\$90,000
1000 GPM CAPACITY	EACH	1	\$52,500	\$52,500
1200 GPM CAPACITY	EACH	1	\$60,000	\$60,000
12 INCH PIPE	L.F.	300	\$30	\$9,000
CATCH BASIN TYPE 2	EACH	15	\$2,000	\$30,000
TOTAL OIL/WATER SEPARATOR COST				\$437,500

ITEM	UNIT	QUANTITY	UNIT PRICE	COST
PUMP STATION IMPROVEMENTS				
CONTROL SYSTEMS	EACH	2	\$35,000	\$70,000
30 HP PUMP	EACH	9	\$25,000	\$225,000
50 HP PUMP	EACH	1	\$30,000	\$30,000
TOTAL PUMP STATION COST				\$325,000

TOTAL SYSTEM IMPROVEMENT COST	\$1,075,745
8.2 % SALES TAX	\$88,211
15% DESIGN ENGINEERING	\$161,362
10 % CONTINGENCY	\$107,575
TOTAL COST	\$1,432,892

4 - SCHEMATIC DESIGN PHASE

Summary

The schematic design plans of the proposed improvements is included in Appendix F of the appendices.

4.1 - Conveyance System Schematic Design

The storm drainage design of the recommended improvements was designed with a pipe material having a Manning's "n" value of 0.014 or smooth wall interior pipe. Different pipe materials (concrete, steel, aluminum or polyethylene) can be used dependent on adequate cover and interior treatment.

4.2 - Pump Station Schematic Design

The pump specifications call for nine 30 horsepower and one 50 horsepower axial flow pumps, 1200RPM, 440 volt, 3 phase, 60 hertz vertical solid shaft motors. The control panels will consist of soft starts and milltronics programmable level controls. See the next pages for catalog schematics.

4.3 - Oil/Water Separator Schematic Design

The oil water separators would be coalescing type oil water separators manufactured by PIPE Inc., Utility Vault Co. or an equivalent type. The separators have a design flow of between 300 gpm to 1200 gpm. See the table on the following pages for a summary of the oil/water separator improvements.

**KING COUNTY INTERNATIONAL AIRPORT
OIL/WATER SEPARATOR TABLE**

7/12/95

SEPARATOR	STRUCTURE NODE #	PERVIOUS AREA	IMPERVIOUS AREA	TOTAL AREA	6 MONTH FLOW	6 MONTH FLOW	DESIGN FLOW
		ACRES	ACRES	ACRES	CFS	GPM	GPM
EXISTING							
A	83	35.72	50.92	86.64	3.36	1505	
B	141A	4.13	44.96	49.09	4.32	1935	
C	187	0.80	29.93	30.73	2.68	1201	1200
D	463A	0.25	4.54	4.79	0.57	255	300
E	443	0.35	14.72	15.07	1.76	788	800
F	493	2.80	9.44	12.24	1.13	506	600
G	563	1.40	3.35	4.75	0.44	197	200
H	631	2.33	13.37	15.70	1.59	712	800
I	683	5.80	9.97	15.77	1.25	560	600
PROPOSED							
J	283	0	9.64	9.64	1.16	520	600
K	295	0	4.92	4.92	0.63	282	300
L	305	0	4.04 43.73	4.04 43.73	0.47	211	300
M	433	0	6.10	6.10	0.73	327	400
N	539	0	10.72	10.72	1.15	515	600
O	429	0	16.97	16.97	1.99	892	1000
P	673	1.00	8.68	9.68	1.06	475	600
Q	675	0.50	6.64	7.14	0.82	367	400

SCHEMATICS

CONTROLS

PUMPS

COALESCING PLATE OIL/WATER SEPARATORS



MILLTRONICS

MultiRanger Plus

Non-contacting Ultrasonic Level Measurement



KCSlip4 35301

SEA401846

MultiRanger Plus

MEDIUM RANGE EASY TO USE LEVEL/VOLUME MEASUREMENT

With the introduction of the MultiRanger Plus, Milltronics has brought ultrasonic technology to a new state of simplicity. We feel confident you will find this system the most field friendly, non-contacting system yet devised.

Now, more easily than ever before, you can monitor level or volume of bulk solids and liquids in heights to 15 meters (48 feet).

VERSATILITY

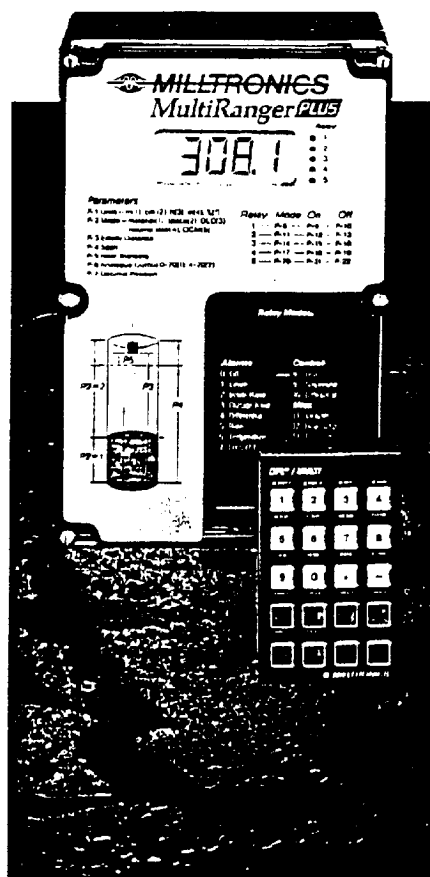
Versatility is the heart of this system. In addition to standard tank or bin level measurement, MultiRanger Plus monitors open channel flow, determines actual lift station throughput, controls as many as five pumps in wet wells, and can measure and control the differential between two levels.

As successor to our innovative MultiRanger, the MultiRanger Plus broadens application ranges even more, especially in the water and waste water industries, with extended open channel and multi-pump functions.

EASE OF USE

Simplicity is provided for in every aspect. For example, to ensure ease of use among those unfamiliar with microprocessor technology, all set-up functions are completely segregated from one another.

Operation is as easy as touching the keypad, and yet, you will not inadvertently slip into any other function.



EASY SET-UP

This simplicity extends to the ease with which you can install the transducer and electronics. Virtually anyone can install, set-up and operate MultiRanger Plus without specialized tools or training. It really is that straightforward.

COST-EFFECTIVENESS

This system is extremely economical. The continual cost of maintenance associated with mechanical systems and old style ultrasonics is eliminated with a MultiRanger Plus. It is a maintenance-free system.

Further, in utilizing current advances in micro-processor technology, we have produced a system which is competitively priced.

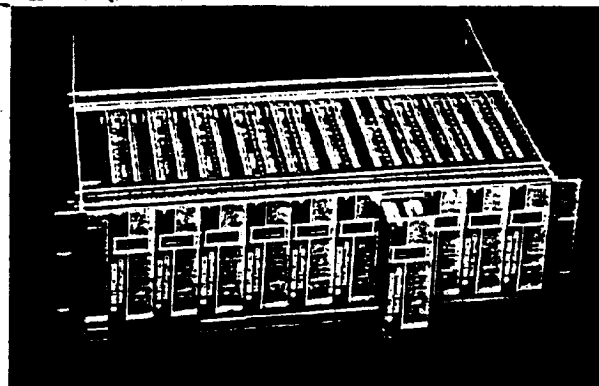
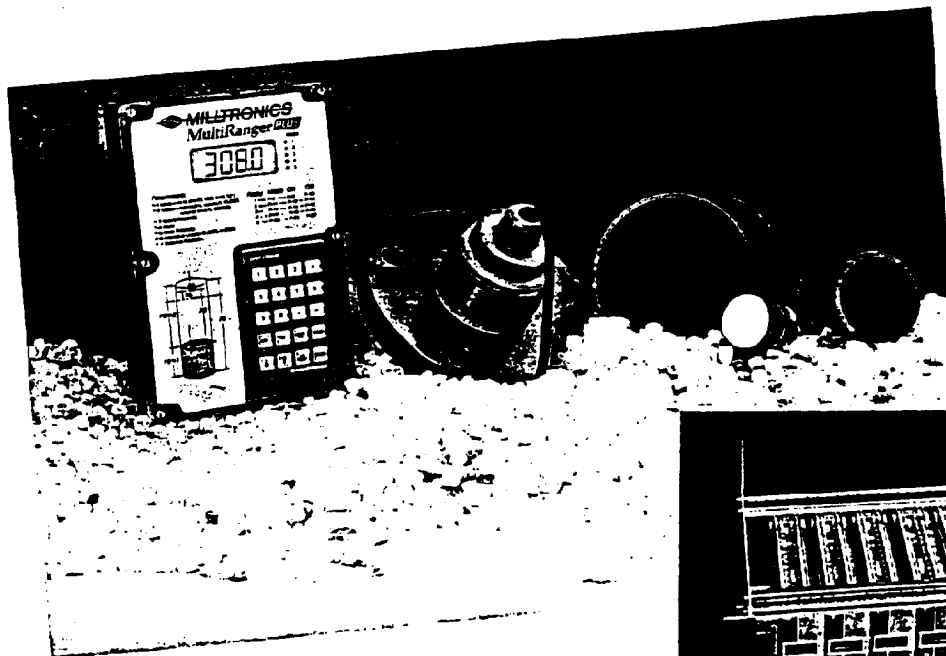
ULTRASONIC TECHNOLOGY

Traditionally, level measurement is determined through a straight electronic conversion of the time taken for a transmitted ultrasonic pulse and its reflected echo to travel between the transducer and the monitored material.

THE RELIABILITY OF PROGRAMMED ECHO ENHANCEMENT

Improving upon basic technology, this system stores a continually updated ultrasound profile of the monitored bin in its computer memory and, through use of an instantaneous, powerful software technique for echo enhancement, assures an extraordinary degree of reliability. The result is completely self-adjusting operation in the most demanding environments. Further, this patented program of echo analysis (BFL), renders obsolete the nuisance of all traditional single function TVG/AGC/gating and tone decoding techniques. The major significance of this development is that MultiRanger Plus improves the efficiency of level measurement and allows you to get on with other business.

Milltronics' latest innovations in ultrasonic technology are based on twenty years of research and development, and upon a thorough understanding of the realities of every day field experience. In selecting the MultiRanger Plus for your materials handling, you will be putting the measure of technical excellence at your service.



Design features emphasize ease of use and reliability

MULTI-PURPOSE VERSATILITY

MultiRange Plus monitors bulk solids or liquids levels of up to 15 meters (48 feet) in virtually any vessel. This allows you to stock one system for all short to medium range applications.

SELF-ADJUSTING OPERATION

The design of the patented software eliminates the need for operator involvement after the initial calibration. You simply key in the vessel dimensions, display format, and alarm settings. Then, even on applications characterized by dust, turbulence, steam, or agitators, the system is completely self-adjusting because the MultiRange Plus alters its echo enhancement technique with every momentary variation in bin conditions.

RESOLUTION/ACCURACY/ RELIABILITY

Achievable resolution is 0.1% of range or 2 mm, with accuracy to 0.25% of range or better.

AUTOMATIC VOLUME CALCULATION

Volume conversion of the level information is readily available for eight different vessel configurations. For readout on the four character LCD display, select either a percentage of volume or any standard engineering unit.

VOLUMETRIC FLOW

For applications involving sewage lift stations which require calculation of capacity utilization, the system provides a determination of volumetric flow through the wet well. In any remote location the mA output can indicate well level while the unit displays a local reading, and/or transmits a remote reading, of total volume pumped.

AGITATOR AVOIDANCE

A unique echo processing feature ensures reliable operation and stable readings in applications in which agitators or other stirring devices are used.

SHORTEST MINIMUM RANGE

To reduce lost tank capacity, the MultiRange Plus provides an adjustable blanking distance as short as 300 mm (12 inches).

ENVIRONMENTALLY SEALED SYSTEM

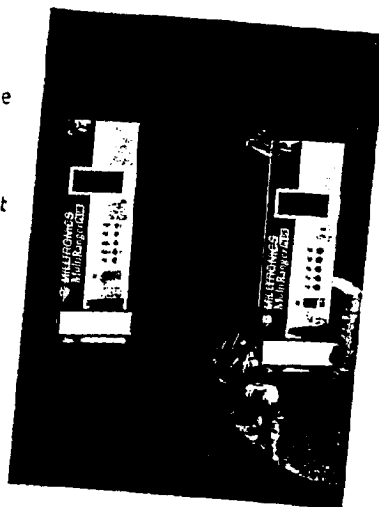
After initial installation, the NEMA 4 enclosure need never be opened, eliminating the potential for electric shock hazard, and dust, or water contamination. For easy, safe operation, the magnet backed access programmer slips into the docking bay and communicates with the electronics via a beam of infrared light.

PUMP CONTROL FUNCTIONS

Everything you need for efficient pump control, these functions are geared specifically to those applications with special pump sequencing requirements. Even running time for each pump is automatically totalled, facilitating the scheduling of regular maintenance.

MultiRanger Plus Rack Mount Unit

MultiRanger Plus is also available in a rack mount version which combines the most sophisticated construction techniques with modern surface mount component technology. Packaged specifically for use in rack or panel cassettes, this compact version permits ten units with integral power supplies to be housed in a 3U, nineteen inch rack. It offers a new concept in programming with a handheld calibrator capable of programming more than one unit simultaneously.



Standard features include:

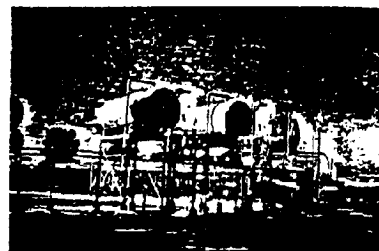
- true plug-in cassette units requiring no hard wiring when replacing or exchanging units
- no separate power supply required; 24 VDC or common AC voltage power inputs standard
- each cassette unit has a fully isolated analogue output for easy hook-up to computer equipment
- each cassette unit has 5 dry contact relays and incorporates all existing MultiRanger Plus features



Monitoring bulk solids materials.



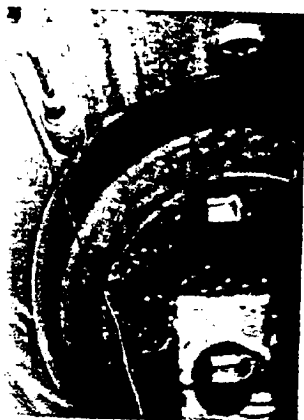
Monitoring level in a waste water facility.



A chemical tank application

MultiRanger Plus monitors level of bulk solids and liquids in meters, feet, centimeters, inches, percent, or volume readout, in vessels of virtually any configuration. Our easy aimer kit assures efficient transducer aiming.

Volumetric measurement in all common tank types provides for a precise readout of volume as required in so many demanding applications — in engineering units you select as most convenient.



Monitoring a duplex pump station.



Monitoring a typical open channel

MultiRanger Plus will control level in wetwells, reservoirs, or general sump applications with as many as five pumps. You may select either pump or alarm indication with complete flexibility.

As an open channel monitor MultiRanger Plus provides flow indication, totalization, flow or level alarms, and sample output for a wide range of flumes and weirs.



Used for rake control

Measuring and controlling differential between levels is as simple as installing a second transducer, and selecting that mode.

Specifications:

FEATURES

Modes: level, space, differential level, total pumped volume, and open channel flow

Number of Points: one point level measurement, pump control, and open channel measurement; two points for differential level

Number of Relays: 5 form 'C' (SPDT) relays, 250 VAC, 5 amps (Rack Mount Unit: 4 amps) non-inductive; contacts assignable as alarms, pump control, sample on time or flow, or totalizer

Outputs: milliamp current loop into 350 ohms or 750 ohms, $\pm 0.1\%$ resolution; programmable as either 4-20, or 0-20, 20-4 or 20-0 mA; (Rack Mount Unit: fully isolated into 750 ohms max.)

Alarms: programmable for level, rate of change of level, differential level, exclusive and inclusive band alarm on level, loss of echo and temperature

Display:
units — meters, centimeters, feet, inches, and percent of span
messages — loss of echo (LOE)
shorted or open cable (CABL LOE)
Fast alternative Reading in Run mode with single keystroke

Conversions: eight standard tank shape volume conversions plus custom level/volume facility

Programming: parameters entered into removable programmer via the keypad; values protected in EPROM (no battery back-up required)

Agitator Filters: eliminates echoes from agitator blades

MK3 "Fuzz Filter" to smooth the small variations in level from surface waves etc.

Transducers: ST25 and ST50 separated from electronic unit by up to 366 m (1200 ft) with TG-62 U coaxial cable

CHARACTERISTICS

Displays: high contrast 4 digit 18 mm LCDs
5 LEDs for alarm/pump controls

Rack Mount Unit: 4 digit, 8.75 mm high backlit LCD display

Resolution: the greater of 0.1% of range or 2 mm

Accuracy: to 0.25% or better

Rate Limit: programmable from 0 to 9999 units/min.

Measurement Range:
0.3 to 8m (26 ft) using ST25 series transducers
0.3 to 15m (48 ft) using ST50 series transducers

Blanking: near and far blanking, near from 300 mm; far adjustable as a % of span

Temperature Range: Electronics: -20°C to 60°C (-5°F to 140°F), Rack Mount Unit: -10 to 30°C (see transducer spec sheet 550 for process temperature limits)

Power Supply: 100/115/200/230 VAC $\pm 15\%$ stab selectable (50/60 Hz, 15 VA max.)

Rack Mount Unit: 100/115/200/230 VAC $\pm 15\%$ switch selectable, 50/60 Hz, 10VA or 24 VDC, $\pm 15\%$, 8 W

OPTIONS

12 or 24 VDC* operation, 15 VA max.; * (24 VDC standard on Rack Mount Unit, 8 VA)

Air temperature velocity compensation with TS-2 or LTS-1 probe; -40°C to 93°C (-40°F to 200°F)

Current loop isolator; LIs-1, 300 VAC isolation, LIs-1 NOT necessary with rack mount unit

PHYSICAL DESCRIPTION

Standard unit: Polycarbonate EEMAC/NEMA 4, IP65 rated enclosure: 160 x 240 x 82 mm (6.3 x 9.5 x 3.2 in)

Weight: 1.8 Kg (4 lb)

Rack Unit: 3U x 8HP x KM6II (40.6 W x 128.5 H x 222.5 D mm) 19 in. rack accommodating 10 RMU's

Calibrator: ABS enclosure with polycarbonate membrane keypad, 102 x 66 x 25 mm (4.0 x 2.6 x 1 in), long life 9 V battery

Specifications subject to change without notice

ST SERIES TRANSDUCERS

Milltronics patented non-contacting, ultrasonic transducers are rugged, highly efficient devices. Even in steamy, dusty, corrosive environments they are self-cleaning and maintenance-free. Approved for use in hazardous areas, they can be faced with protective material and flange mounted for corrosive service. Their compact size allows for easy handling and installation.



Approved for hazardous use by:
CSA Class I, Groups A,B,C,D
Class II, Groups F & G



FM Class I, Div I, A, B,C,D
Class II, Div I, Groups E,F & G



CENELEC EEX m II t5



BASEEFA Class Ex s II, Zone 0



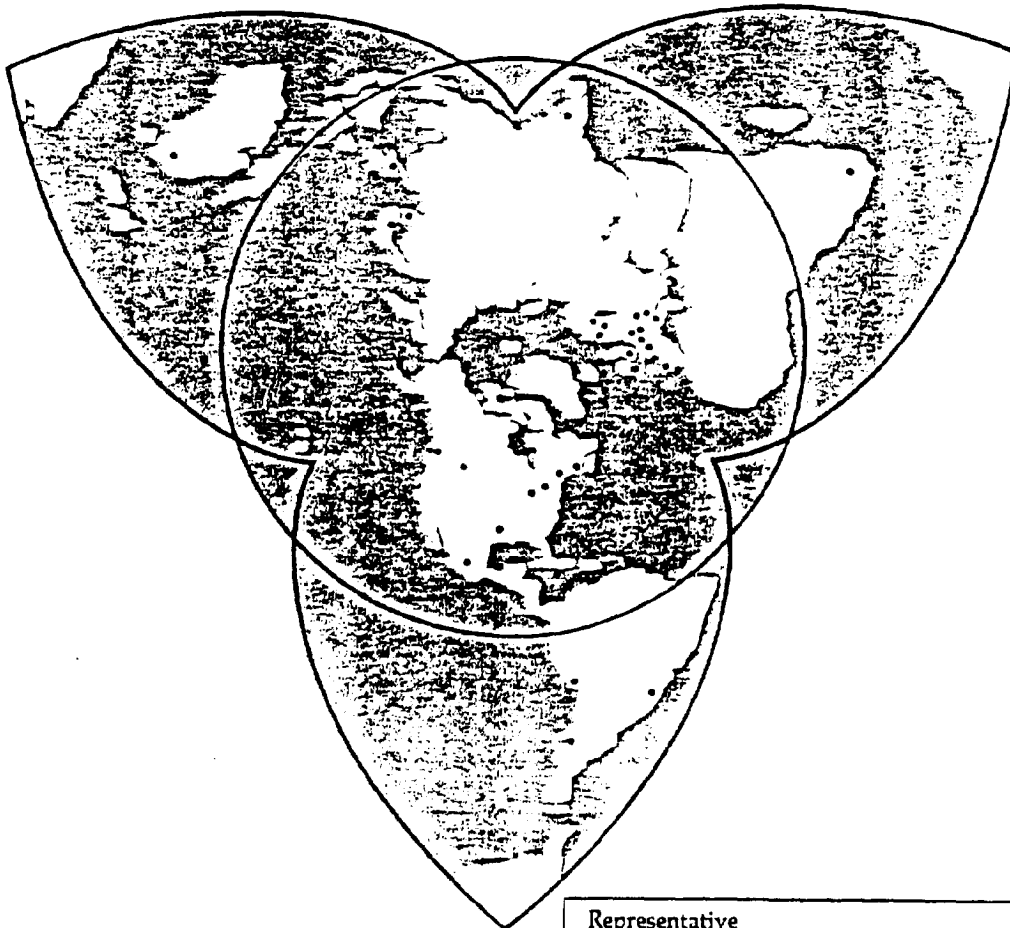
SAA Ex s IIB T5
Class I, Zone 0



Condensed approvals, consult spec sheet 550.

International Representatives

Argentina, Australia, Austria, Belgium, Brazil, Colombia, Chile, Denmark,
Eire, Finland, Germany, India, Indonesia, Israel, Italy, Jamaica, Japan,
Korea, Malaysia, Mexico, New Zealand, Norway, Peru, Philippines,
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Thailand, The Netherlands, Turkey, Venezuela



Improving accuracy and reliability, while simplifying ease of use, is the design basis of each new Milltronics product. You can depend upon us for quality products and service. For assistance helping meet your process measurement requirements, Milltronics representatives are available worldwide.



709 Stadium Drive East, Arlington, Texas 76011
P.O. Box 4225, 730 The Kingsway, Peterborough, Ontario, Canada K9J 7B1
Oakhouse, Everoak Estate, Bromyard Road, Worcester, England WR2 5HP
Château de la Saurine, Pont de Bayeux-BP 6, 13590 Meyreuil/Aix en Provence

Specification sheet (3575) 730 rev. 2 12/92

Representative

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H. D. FOWLER CO., INC.
15442 D. E. C. DR. - DALLAS, TX 75244
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42-65-69-00	Fax: 42-58-63-95	

Printed in Canada

KCSlip4 35306

SEA401851

CONTROLS:

The control circuit shall be mounted within a single section hinged door type NEMA 12 enclosure. It shall have a dead front with safety interlocks on main circuit breakers. The face of the panel shall contain the circuit breaker operators, hand-off-automatic switches wet well level gauge and rotometer gauge and adjustment. All items shall be clearly marked with white and black phenolic engraved labels. Each circuit breaker will have over current protection. Magnetic across the line starters will have overload protection in each leg and under voltage release.

Magnetic across the line starters with under voltage release shall be provided for each pump. The starters shall have thermal overload heater coils. All wiring shall be numbered for ease of trouble shooting.

Panel shall include the following:

1. Green/Red pump On/Off lights
2. Running Time Meters
3. Phase/Voltage Monitor
4. Lag Pump Start Delay

The pumps shall be controlled by a bubbler system. It shall consist of a ITT-LGH-310, 1/4HP, stored air system that will charge the storage tank automatically. Compressors of the diaphragm type running continuously will not be acceptable. The air compressor shall be mounted outside the control panel to protect controls from excessive vibration.

An automatic alternator shall be an integral part of the control circuit to change the sequence of the pumps at the completion of each pumping cycle. It shall be designed to bring in the alternate pump should the lead pump fail to pump for any reason. The design shall also provide for parallel operation of the pumps in the event the wet well level continues to rise above the level of the low level starting. Air flow meter, wet well gauge, and alternator shall be District's Standard. (see attached list).

LIGHTING:

A dual fluorescent light shall be attached to the top of the pump station. It shall have a manual over ride switch at the top of the ladder. A combination drip and protective shield shall be an integral part of the light. It shall be painted with a highly reflective baked enamel. The bulb and starters should be readily accessible for maintenance. The design and wiring shall be that one light will still operate with failure of bulb or starter of the defective light. Complete with bulb guards.

WIRING:

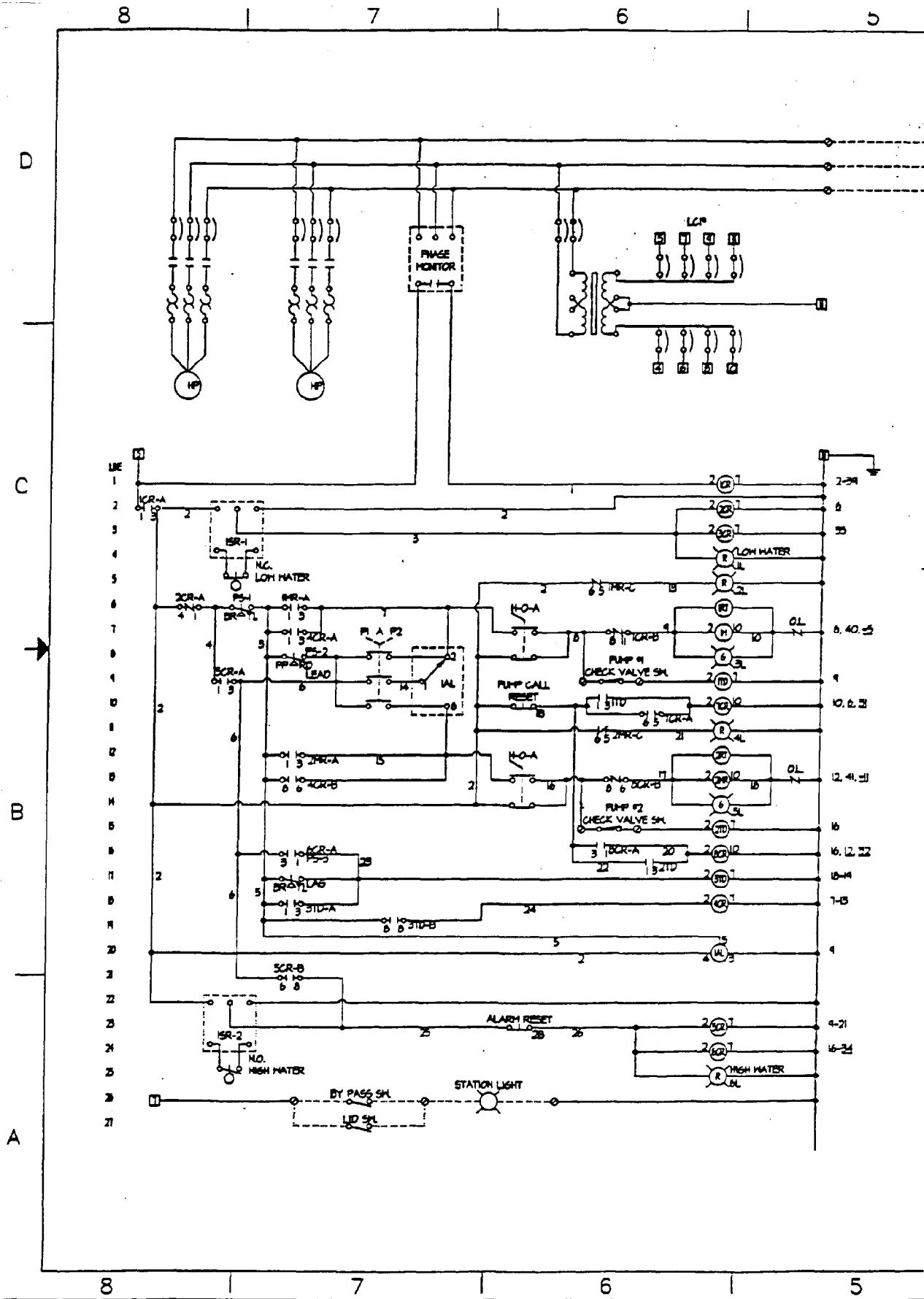
The pumping station shall be completely wired at the factory, except for the power feeder lines. The control panel, all interior and exterior wiring, and equipment wiring shall conform to the National Electrical Code and meet all state and local codes. All equipment shall meet applicable standards of NEMA, ANSI, IL, and IPCEA. Convenience outlets shall be provided for such items as dehumidifier and blower. Ground fault interrupters (G.F.I.) convenience outlet Leviton 6599-1 shall be mounted within the station (1 each) and 6" below the top of entrance tube (1 each).

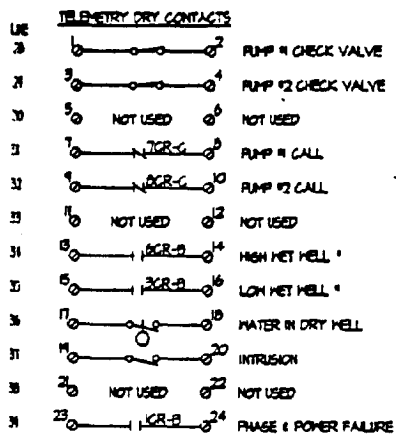
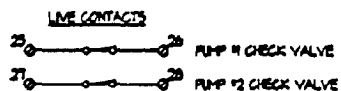
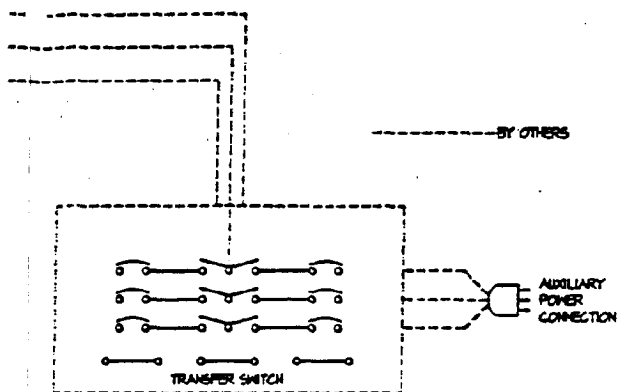
A load center shall be mounted on the station wall as indicated with circuit breakers for each accessory item clearly labeled.

A 5KVA transformer shall be supplied to provide power for the accessory items.

DEHUMIDIFIER:

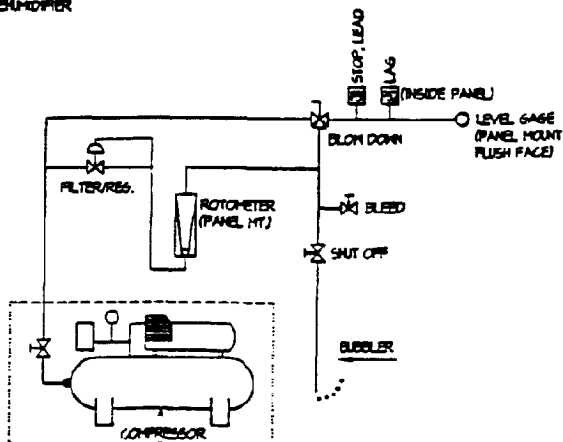
A self contained automatic dehumidifier shall be wall mounted and accessible for easy inspection and maintenance. It shall consist of a hermetically sealed freon refrigeration type compressor. The unit shall be life time lubricated with a 1/5 HP motor with built in thermal overload protection.





- *LC
- ① TELEMETRY (IF REQ'D)
 - ② CONTROL
 - ③ COMPRESSOR
 - ④ STATION LIGHT
 - ⑤ HEATER
 - ⑥ OUTLETS/BLOWER
 - ⑦ SUMP PUMP
 - ⑧ DEHUMIDIFIER

*CLOSED IS NORMAL
OPEN FOR ALARM



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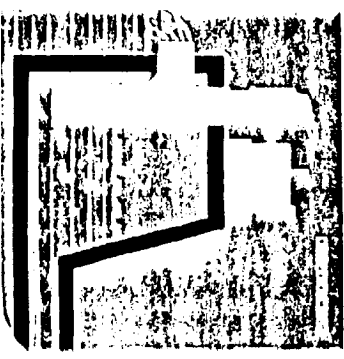
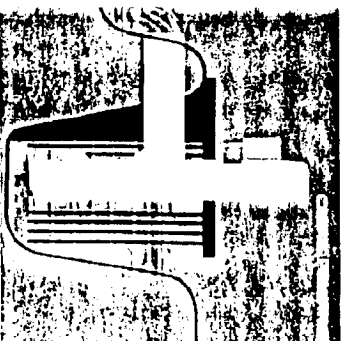
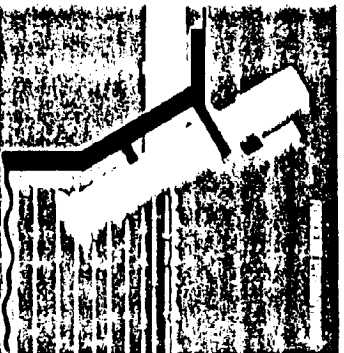
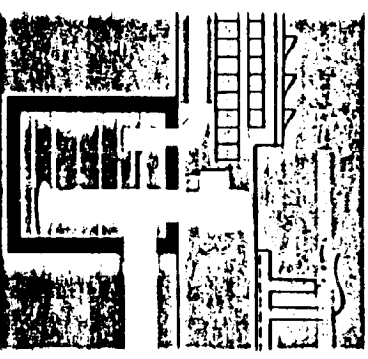
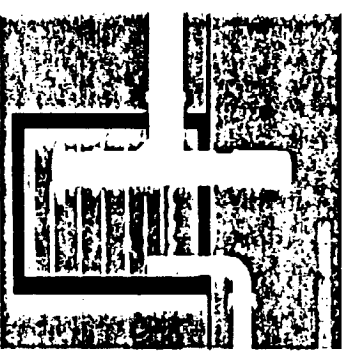
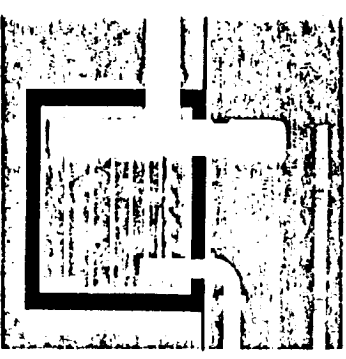
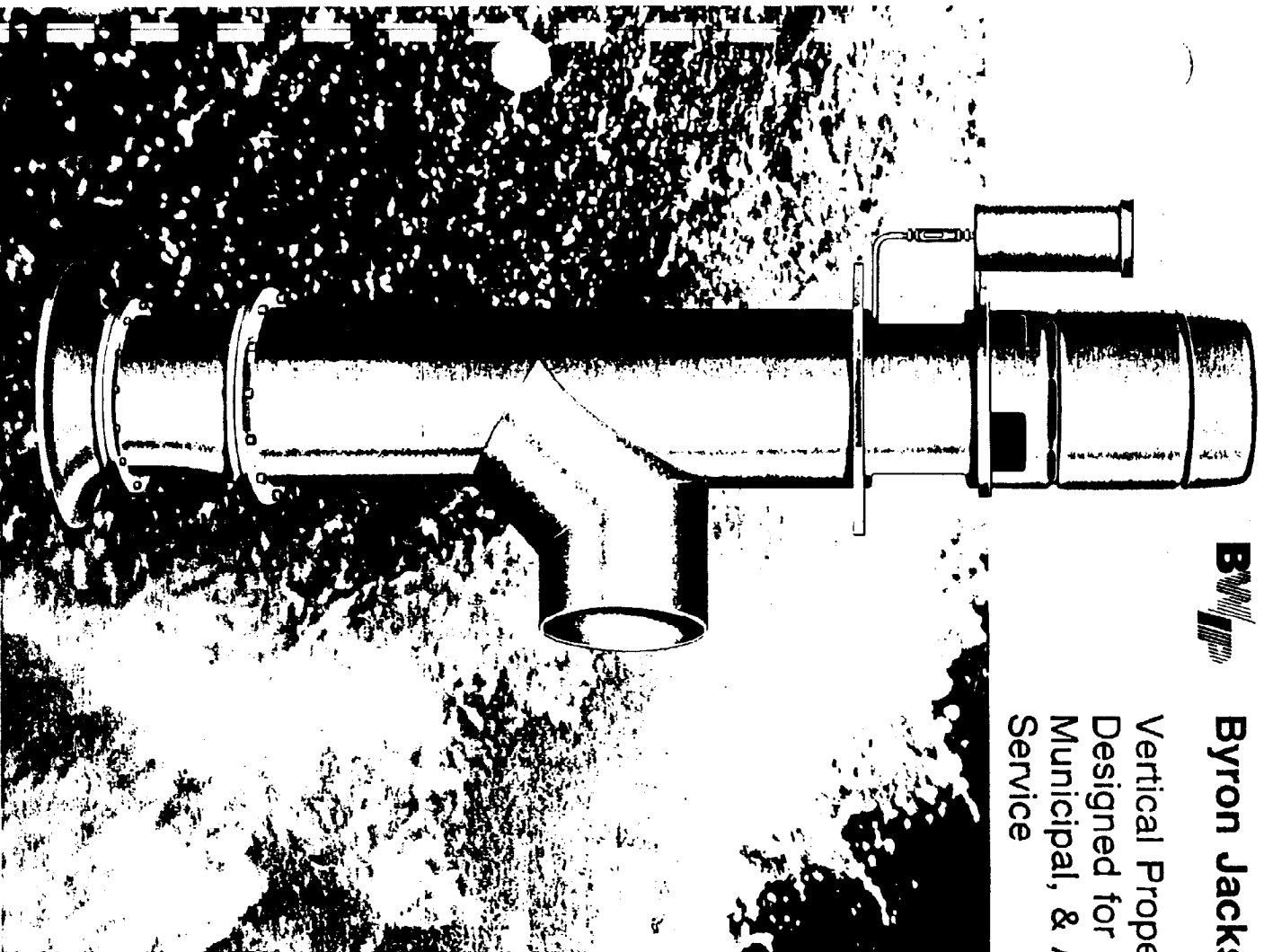
**STEEL PUMP STATION
BUBBLER SYSTEM**

REV B	DATE 6-1-93	REV NUMBER 2825PS
DESIGN NTS	REV NUMBER E1.DWG	SCALE 100'-10"

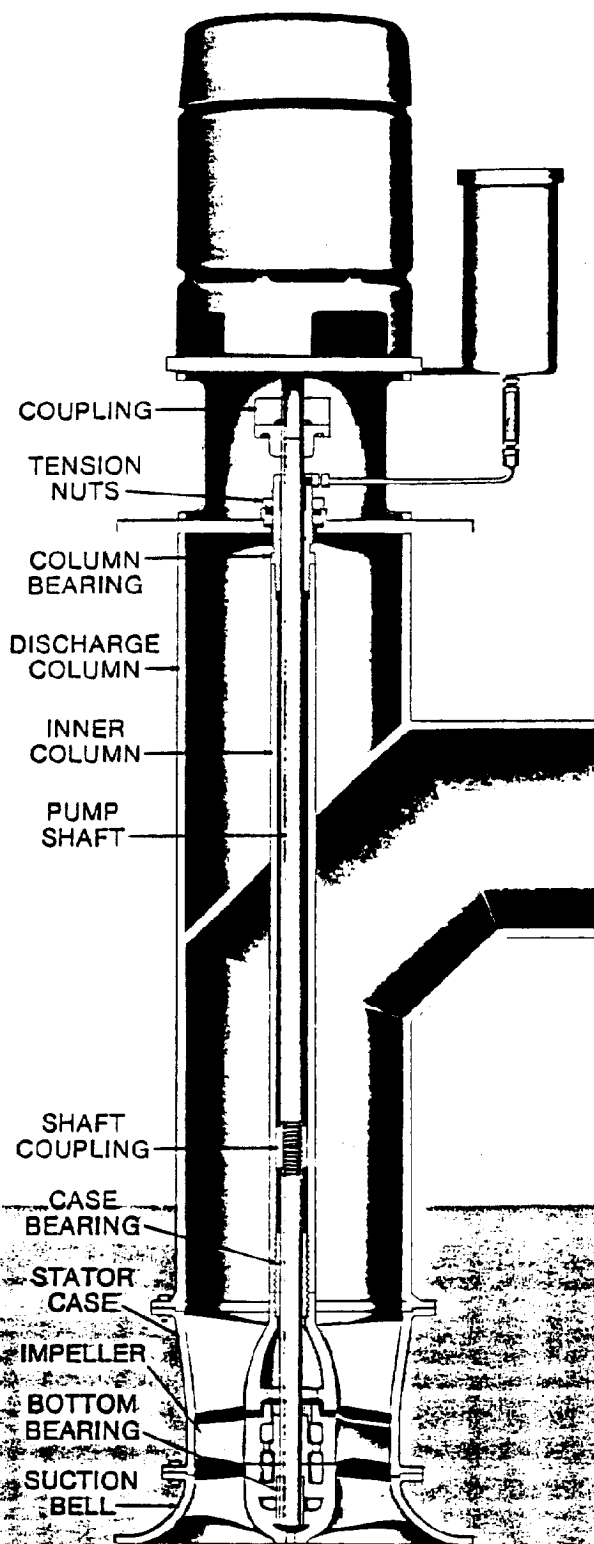


Byron Jackson®

**Vertical Propeller Pumps
Designed for Industrial,
Municipal, & Agricultural
Service**



KCSlIp4 35310



THE BYRON JACKSON TYPE "D" VERTICAL PROPELLER PUMP is constructed of selected components and materials. It is designed for rugged, economical and dependable service with a minimum of repairs. The owner of a Byron Jackson pump has the assurance of a full one year warranty; backed up by a strong national service organization. Years of integrity and experience — since 1872 — goes into the building of these pumps. Experience and reliability are priceless commodities. Quality costs less in the long run.

DISCHARGE ELBOW AND COLUMN — The basic unit has a combination heavy gauge fabricated steel discharge, suspension column and driver mounting base. All connections between column and bowls are registered fits with machined flanges and assembled with through bolts for ease of assembly and alignment. Lengths may be furnished to meet any requirements.

INNER COLUMN — Extra strong steel pipe encloses the turned, ground and polished 1045 shafting. It is connected with high-grade bronze bearings, spaced no more than 5 feet apart. Alignment is accomplished through use of a heavy duty tension bearing on the top end. Lubrication is normally oil, but fresh water and self lubrication are available as an optional standard.

PUMP ELEMENT — The pumping element is constructed of class 30 cast iron stator case and large diameter suction bell, bronze propeller and bearings, with a Type 416 S.S. shaft. The impeller is locked on the shaft against axial movement. Rigid quality control and inspection standards assure smooth, high efficiency operation.

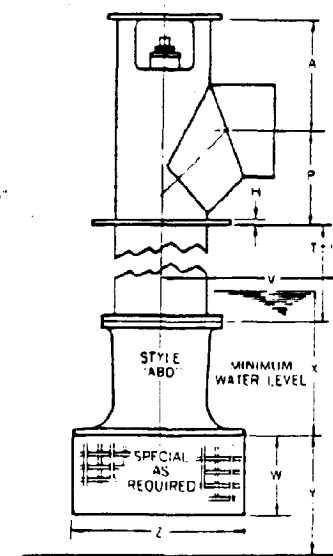
QUALITY CONTROL — Casting reliability with predictable physical properties and uniform structure in every section of a casting and from casting to casting. Every casting is porosity free, pressure tight and wear resistant. All Byron Jackson fabricated pump components use ASME certified code welders.

EASY TO INSTALL — Most pumps are shipped fully assembled (less driver). Field installation is simplified.

DRIVER — Vertical solid shaft construction is standard. However, Vertical Hollow Shaft motors and gears are available depending on User preference.

ADVANTAGES

- SELF PRIMING
- SIMPLE INSTALLATION
- LOW SPEED—REDUCED WEAR
- AVAILABILITY FROM STOCK
- FLANGED CONSTRUCTION
- HIGH QUALITY STANDARDS
- LOW OPERATING COSTS
- OIL OR SELF LUBRICATING



(1) 30" pumps will have 20" column above discharge 6-24" flange at top of bowl.
 (2) 36" pumps will have 20" column above discharge 6-20" flange at top of bowl.
 (3) 48" male register.
 NOTES:
 Dimensions A, B, Y and Y are min. As B and F may be varied to suit application.
 "C" Dimension - while these units are not recommended for pumping solids, "C" equals maximum size sphere which will pass through pump without clogging valve.
 "D" is size of (CBP) bearing utilized in top case.
 "E" - For best results in sump positions, a minimum distance of 4" to 6" the bell diameter, "K", or at least 54" "K" (no less) should be maintained. A distance between "K" and 41" "K" is not recommended.

Range Chart

		TOTAL HEAD IN FEET																									
		3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	18'	20'	22'	24'	26'	28'	30'	32'				
PUMP SIZE	FLOW G.P.M.	CAPACITY IN GALLONS PER MINUTE																								PUMP SIZE	
3"	1800			1020	1000	950	925	875	800	725	650	550	450												3"		
3"	5	1800			1500	1500	1450	1400	1350	1250	1200	1100	1000												3"		
3"	5	1800										1020	990	950	920	880	810	730							3"		
3"	7 1/2	1800								1370	1330	1300	1260	1230	1190	1150	1070	970	850	680					3"		
12"	3	1200		1280	1120	980	850	750	620	530															12"		
12"	3	900	2100	1900	1580	1440	1200	740																	12"		
12"	3	1200			1280	1210	1130	1040	910	700	520														12"		
12"	5	1200		1900	1800	1675	1540	1390																	12"		
12"	5	1200					1540	1410	1300	1170	1000														12"		
12"	7 1/2	1200	3000	2900	2800	2700	2500	2300	2200	2000	1700	1400	1200	1000											12"		
12"	10	1800			2350	2300	2250	2200	2150	2050	1950	1900	1800												12"		
12"	10	1800									1910	1870	1830	1770	1710	1580	1410	1230	950						12"		
12"	15	1800			3000	2950	2900	2800	2700	2600	2550	2500	2400												12"		
12"	15	1800													2370	2230	2070	1920	1720						12"		
12"	25	1800							4300	4230	4160	4080	4000												12"		
18"	5	720		3150	3000	2850	2650	2500	2250	1950	1400														18"		
18"	7 1/2	720	4100	3900	3500	3000	1800																		18"		
18"	10	900			3725	3575	3400	3200	3025	2800	2500	2200	1800												18"		
18"	10	900		4400	4400	4300	4150	3750	3425	3100															18"		
18"	15	900	5500	5500	5300	5000	4675	4350	3900	3550	2400														18"		
18"	15	900						3750	3600	3400	3250	3100	2900	2700	2100	1325									18"		
18"	20	1200						3900	3900	3850	3650	3550	3450	3350	3100	2800	2550	2100	1700	1450					18"		
18"	20	1200			5575	5560	5400	5220	5030	4800	4525	4400	4200												18"		
18"	25	1200								5700	5500	5275	5050												18"		
18"	25	1200							4950	4850	4800	4700	4600	4500	4400	4150	3900	3650	3350	3000					18"		
18"	30	1200				6900	6900	6850	6750	6515	6350	6100	5850												18"		
18"	30	1200												5150	5050	4850	4600	4400	4100	3850				18"			
18"	40	1200												6200	6100	5900	5650	5350	5000	4750	4400	4000	3250		18"		
18"	50	1200												7225	7200	7000	6750	6400	6100	5700	5250	4800	4250		18"		
24"	30	720			10000	9600	9200	8800	8000	7250															24"		
24"	40	900				9550	9400	9050	8700	8350	8000	7800	7200												24"		
24"	50	900					11050	10900	10600	10250	9910	9550	9150												24"		
24"	50	900										8600	8400	8050	7650	7200	6650								24"		
24"	60	900					13000	12900	12550	12150	11750	11350	10900	10500											24"		
24"	60	900									10900	10700	10500	10300	9900	9500	9000	8300	7500						24"		
24"	75	900											10800	10650	10250	1850	3400	8850	8100	7200	5600	4450			24"		
24"	100	900													14000	13500	13000	12600	12000	11400	10500	9400			24"		
24"	25	720		10400	10000	9600	9200	8800	8400	8000															24"		
24"	30	720		12000	11500	11000	10500	10000	9500	9200															24"		
24"	40	720		13600	13000	12400	11000	11400	11000	10800															24"		
24"	50	720		14800	14400	14000	13600	13200	12600	12000															24"		
24"	50	900		13000	12800	12500	12100	11800	11500	11200	10800	10600	10300	10000											24"		
24"	60	900		15000	14800	14400	13900	13500	13200	12900	12600	12300	11800	11500											24"		
24"	75	900		17000	16600	16200	15800	15400	15000	14600	14200	13900	13700	13500											24"		
24"	100	900		18500	18000	17600	17200	16800	16400	16000	15800	15600	15300	15000											24"		
		TOTAL HEAD IN FEET																									
		15'	16'	17'	18'	19'	20'	21'	22'	24'	26'	28'	30'	32'	34'	36'	38'	40'	42'	44'	46'	48'	50'				
PUMP SIZE	FLOW G.P.M.	CAPACITY IN GALLONS PER MINUTE																								PUMP SIZE	
24"	75	720	13000	12500	12250	12000	11750	11500	11250	10000	10200	9300	8400	7500											24"		
24"	100	720	17750	17250	17000	16750	16500	16250	15600	15000	13800	13000	12000	11000											24"		
24"	125	720	21200	21000	20600	20200	20000	19750	19500	19500	18000	17750	16750	15000	13250										24"		
24"	150	900					17000	16800	16600	16400	16100	15800	15200	14800	14400	13800	13200	12600							24"		
24"	200	900							21800	21500	21200	20700	20300	19800	19300	18700	18000	17400	16800	15600					24"		
24"	250	900										26000	25600	25200	24600	24100	23600	23000	22000	21000	20000				24"		

WHERE HIGHER HEADS OR CAPACITIES ARE REQUIRED, ASK ABOUT OUR "HQD" VERTICAL CIRCULATOR PUMPS



BW/IP International, Inc.
Pump Division

200
Oceangate
Boulevard
Suite 900

Long Beach
California
90802

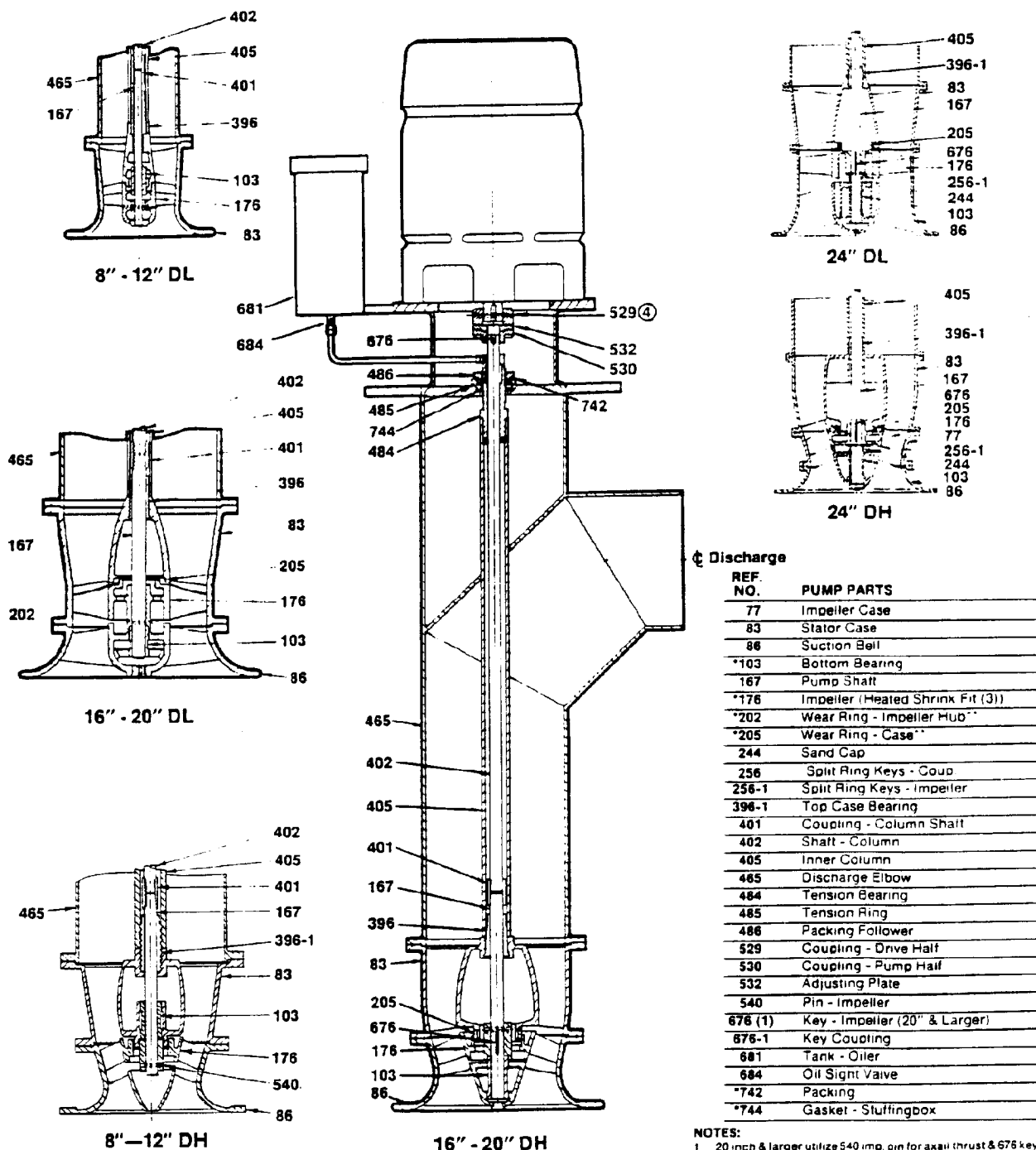
Bulletin 2-180
Printed in U.S.A.
7/90

KCSlip4 35313

SEA401858

TYPE D VERTICAL PROPELLER PUMPS

Sectional Drawing Type DL & DH



When ordering parts refer
to Pump serial number

Drawing 427553

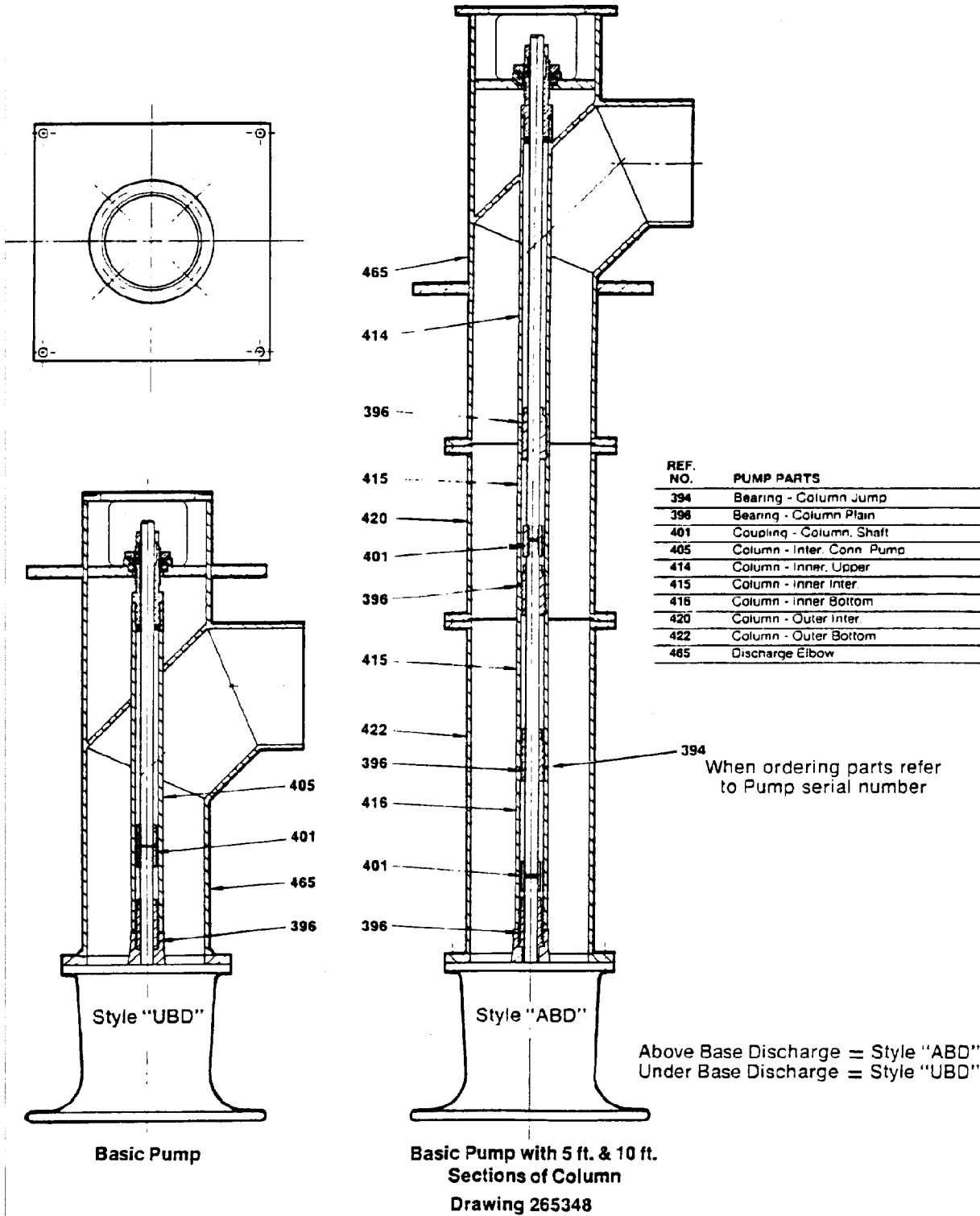
NOTES:

- 1 20 inch & larger utilize 540 imp. pin for axial thrust & 676 key for rotational torque
- 2 Motor coupling key shipped by motor manufacturer inside junction box.
- 3 Impeller is a heated shrink fit on pump shaft (except for 20" and larger)
- * Recommended spare parts.
- ** Optional construction available at extra cost.
- 4 See Page 2-180-2 1 for detail



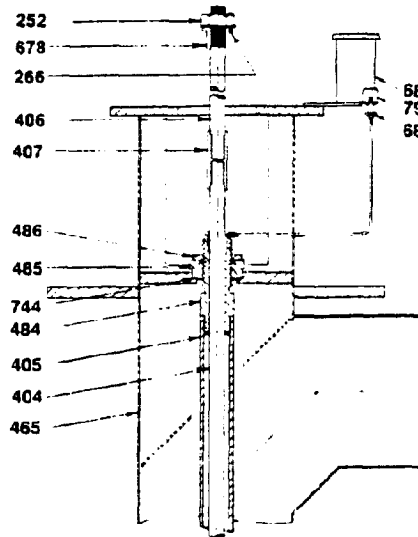
TYPE D VERTICAL PROPELLER PUMPS

Basic Pump Sectional Drawing

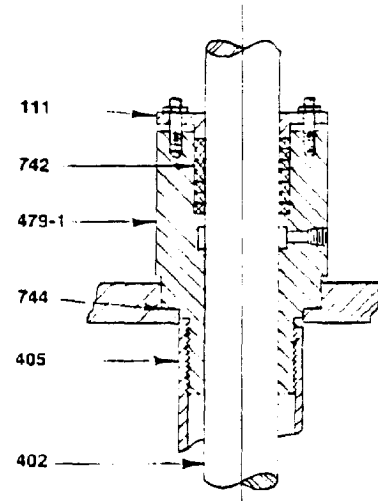


TYPED VERTICAL PROPELLER PUMPS

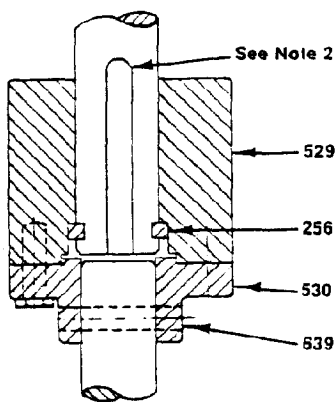
Sectional Drawings



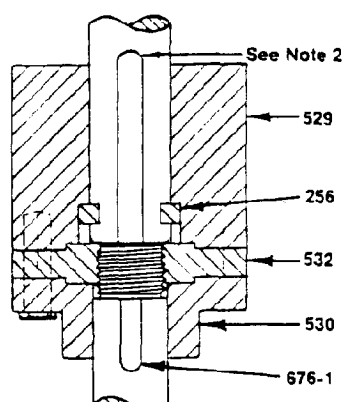
Used With VHS Motors



Packed Type Tension Nut
Fresh Water Injection



Two Piece Coupling
DL Units Only



Three Piece Coupling
DH Unit Only

REF. NO.	PUMP PARTS
111	Gland
252	Nut-Head Shaft (VHS Motors)
256	Split Half Ring Keys - Coupling
266	Lock Screw-Head Shaft Nut (VHS Mtr.)
393	Column Bearing - Upper
402	Shaft - Column
404	Head Shaft (VHS Motors)
405	Inner Column
406	(1) Motor Shaft (VHS Motor)
407	(1) Coupling - Motor Shaft (VHS Motor)
465	Discharge Elbow
480	Packing Ring
484	Tension Bearing
485	Tension Ring
486	Packing Follower
529	Coupling - Driver Half
530	Coupling - Pump Half
532	Adjusting Plate (Coupling)
539	Pin - Coupling
676-1	Key - Coupling
678	Gib Key (VHS Motor)
681	Tank Oiler
684	Sight Feed Oil Valve
*742	Packing
*744	Gasket
*744-1	Gasket - Round Rubber
749	Tension Nut
749-1	Packed Tension Nut
796	Solenoid Valve

NOTES:

(1) Used with two piece head shaft only

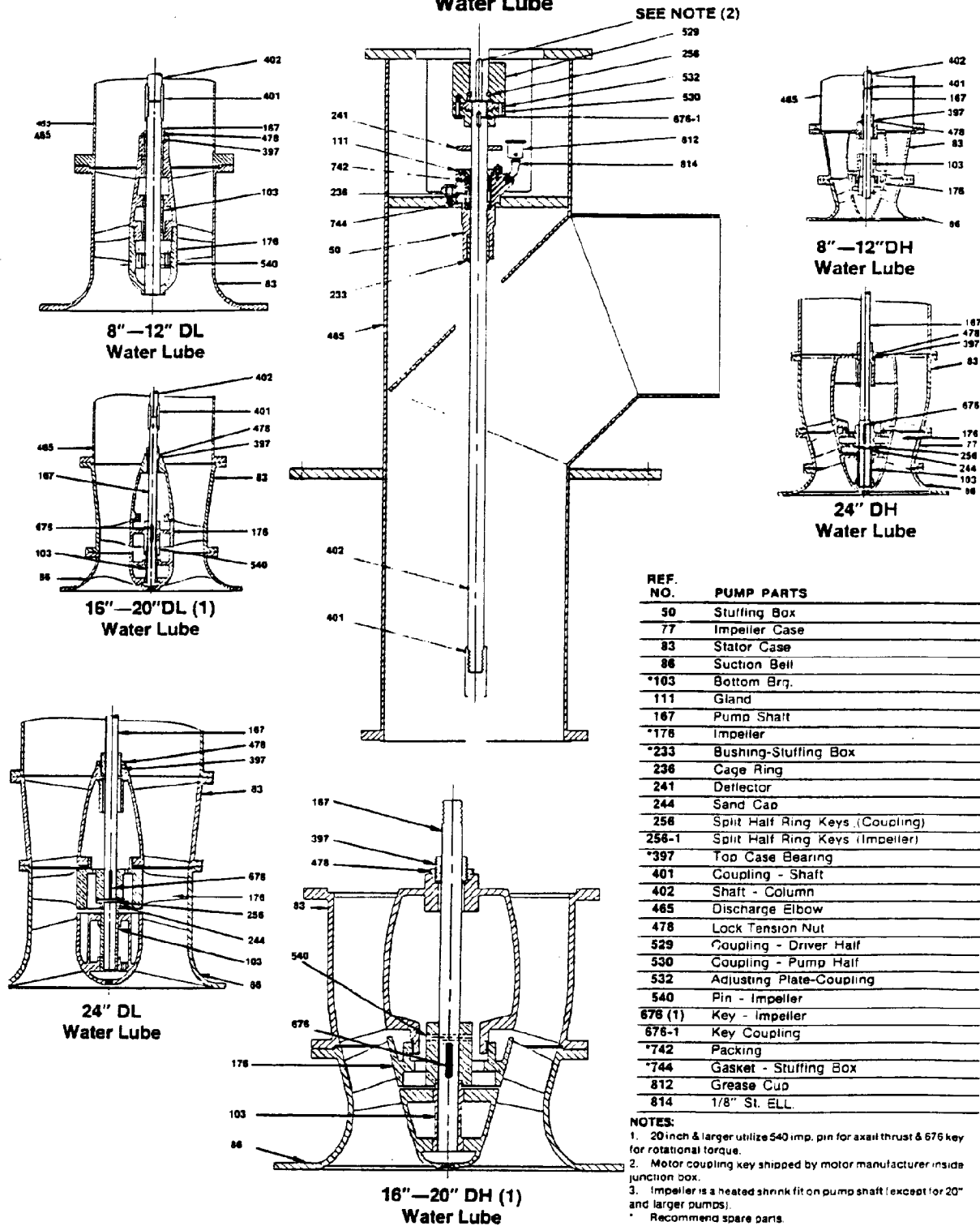
*Recommended spare parts

(2) Motor coupling key shipped by motor manufacturer inside junction box



TYPE D VERTICAL PROPELLER PUMP

Sectional Drawings Type DL & DH Water Lube

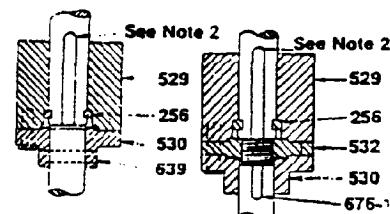
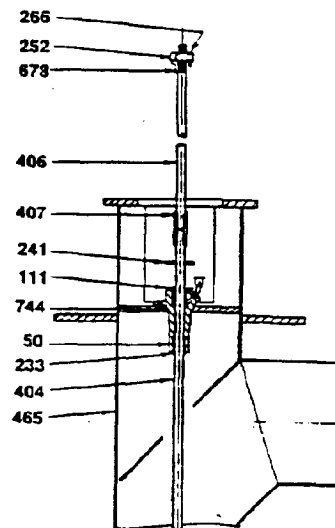
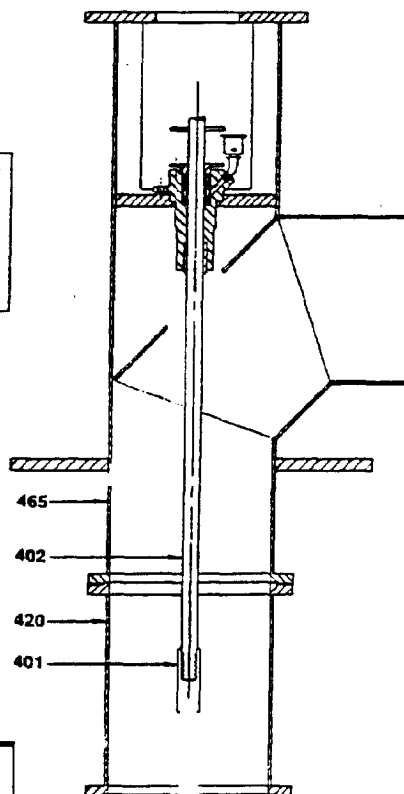
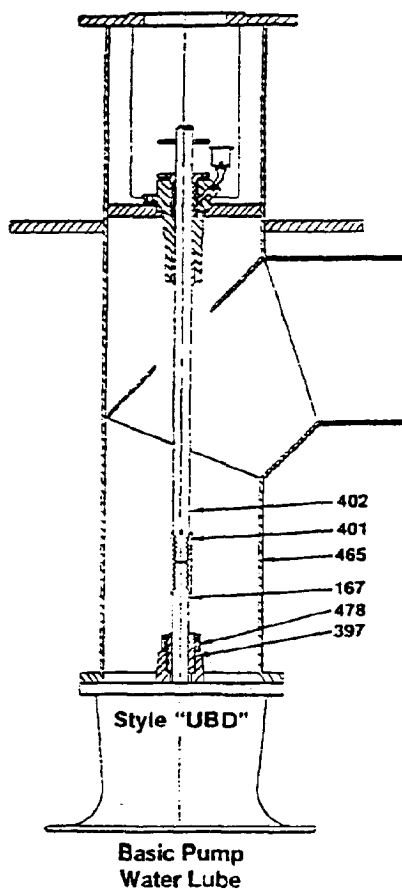
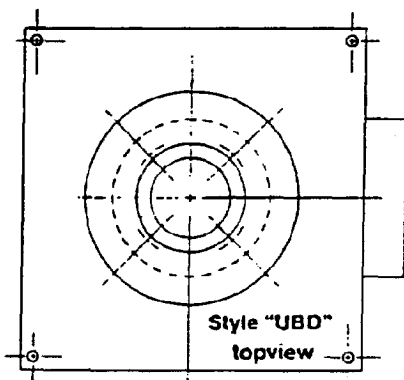


REF. NO.	PUMP PARTS
50	Stuffing Box
77	Impeller Case
83	Stator Case
86	Suction Bell
*103	Bottom Brq.
111	Gland
167	Pump Shaft
*178	Impeller
*233	Bushing-Stuffing Box
236	Cage Ring
241	Deflector
244	Sand Cap
256	Split Half Ring Keys (Coupling)
256-1	Split Half Ring Keys (Impeller)
*397	Top Case Bearing
401	Coupling - Shaft
402	Shaft - Column
465	Discharge Elbow
478	Lock Tension Nut
529	Coupling - Driver Half
530	Coupling - Pump Half
532	Adjusting Plate-Coupling
540	Pin - Impeller
676 (1)	Key - Impeller
676-1	Key Coupling
*742	Packing
*744	Gasket - Stuffing Box
812	Grease Cup
814	1/8" St. ELL.

NOTES:
1. 20 inch & larger utilize 540 imp. pin for axial thrust & 676 key for rotational torque.
2. Motor coupling key shipped by motor manufacturer inside junction box.
3. Impeller is a heated shrink fit on pump shaft (except for 20" and larger pumps).
* Recommend spare parts
** Optional construction available at extra cost.

TYPE D VERTICAL PROPELLER PUMPS

Pump Sectional Drawings Type DL & DH Water Lube



Two Piece
Coupling
DL Units Only

Three Piece
Coupling
DH Units Only

REF. NO.	PUMP PARTS
50	Stuffingbox
111	Gland
220	Sleeve-Shaft
*233	Bushing—Stuffingbox
241	Deflector
252	Nut-Head Shaft (VHS Motor)
256	Split Half Ring Keys - Coupling
266	Lock Screw-Head Shaft Nut (VHS Motor)
397	Top Case Bearing
*399	Bearing - Shaft
401	Coupling - Shaft
402	Shaft - Column
404	Head Shaft (VHS Motor)
406(4)	Motor Shaft (VHS Motor)
407(4)	Coupling-Motor Shaft (VHS Motor)
420	Column - Outer
465	Discharge Elbow
478	Lock Tension Nut
529	Coupling - Drive Half
530	Coupling - Pump Half
532	Adjusting Plate-Coupling
676	Key - Coupling
678	Gib Key (VHS Motor)
*744	Gasket - Stuffingbox

NOTES: (4) used with two piece head shaft only
* Recommended spare parts
(2) Motor Coupling key shipped by motor manufacturer inside junction box



TYPE D & HQD SINGLE STAGE VERTICAL SUMP PUMPS STANDARD MATERIAL SPECIFICATIONS

STANDARD OIL LUBRICATED TYPE "D" AND "HQD" PUMPS WILL BE FURNISHED WITH THE FOLLOWING METALLURGY.

PART DESCRIPTION	TYPE "D"		TYPE "HQD"	
	ASTM No.	COMMON TERM	ASTM No.	COMMON TERM
STATOR (PUMP) CASE	A48	CAST IRON	A48	CAST IRON
SUCTION BELL	A48	CAST IRON	A48	CAST IRON
TOP CASE	NA	NA	A-45-50	CAST IRON
BOTTOM CASE	NA	NA	A-45-50	CAST IRON
IMPELLER	B-145-4A	BRONZE	B-148-9A	AL-BRONZE
BOWL BEARINGS	B-145-4A	BRONZE	B-145-4A	BRONZE
SAND CAP	NA	NA	B-145-4A	CAST IRON
PUMP SHAFT	A-276	416 S.S.	A-276	416 S.S.
IMPELLER KEY	A-276	416 S.S.	A-276	416 S.S.
COLUMN SHAFT	A-108 - GR-1045	C-1045 STL.	A-108 - GR-1045	C-1045 STL.
SHAFT COUPLING	A-108	C-1045 STL.	A-108	C-1045 STL.
INNER COLUMN	A-53	SCHEDULE 80 L.C. STL.	A-53	SCHEDULE 80 L.C. STL.
INNER COL. BEARINGS	B-145-4A	BRONZE	B-145-4A	BRONZE
COLUMN-HEAD FABRICATIONS *	A-53	STEEL	A-53	STEEL
TENSION BEARING	B-145-4A	BRONZE	B-145-4A	BRONZE
PUMP-MOTOR COUPLING	A-107	1020 STEEL	A-107	1020 STEEL

*8, 12, & 16" = 3/16" WALL: 20", 24", 30" & 36" = 1/4" WALL.

TYPE D AND HQD PUMPS—TECHNICAL DATA

Recommended Pump Placement In Sump

The function of the pump intake structure is to supply an evenly distributed flow of water to the pump suction bell. Minimum requirements should be met to assure normal pump performance. These include: (1) the size and shape of the sump to obtain low velocity and even flow distribution; (2) the placement of the pump(s) in the sump considering submergence, clearance from the floor and walls; (3) the location of the trash rack(s) or screen(s). The ideal approach is a straight channel coming directly to the pump. Typical problems associated

with sump configuration are (1) abrupt changes in floor elevation; (2) sudden expansion in the sump area; (3) directional flow changes; and (4) separation due to high inlet velocities. Pump sump designs and placement of the pumps are primarily based on the parameters set by the Hydraulic Institute Standards. The following figures indicate desired placement of the pumps and the recommended basic sump dimensions using the pump suction bell diameter as a base.

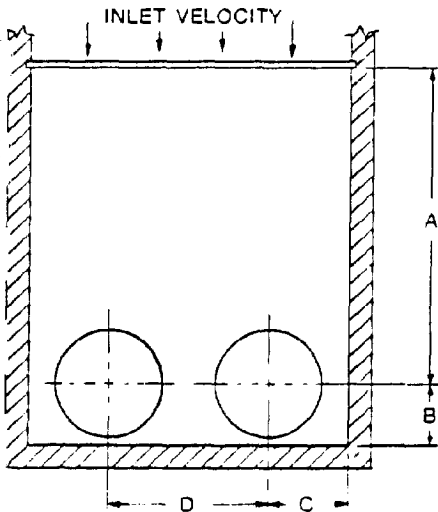


FIGURE 1 - PUMP PLACEMENT

See Bulletin 2-180 for suction bell diameters indicated as "K".
Recommended dimensions in terms of "K"

A = 5 K or 40 feet, whichever is smaller

B = 0.56 K

C = 0.75 K

D = 1.5 K

Maximum inlet velocity 1 foot per second required to assure proper pump performance.

FIGURE 2 - SUPPORT WALLS

With large units the intake structure frequently requires support walls between pumps. The basic dimensions from Figure 1 pump placement still apply. On high capacity units the use of a suction splitter to extend the suction bell diameter may be desirable to maintain 1.5 K channel width. Recommended dimensions for walls:

E = 0.25 K

Min. height of gap = low water level or 10 feet

F = 1.0 K min.

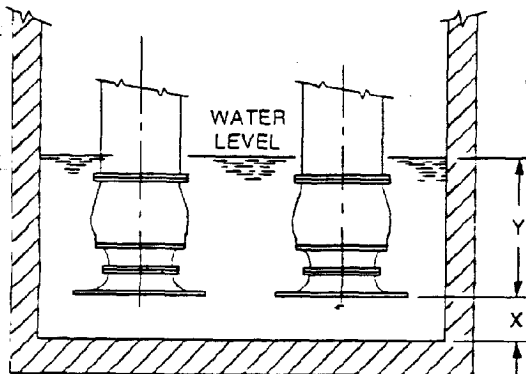
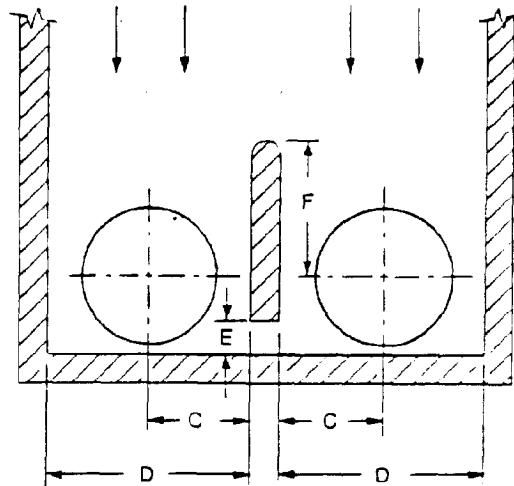


FIGURE 3 - DEPTH OF WATER IN SUMP

See Bulletin 2-180 for submergence requirements. Minimum submergence plus floor clearance may not make up required depth of water to ensure the proper inlet velocity to pumps. To check inlet velocity:

CFS = Cubic ft. per sec.

Q = Capacity - GPM

$$CFS = \frac{Q}{448.8}$$

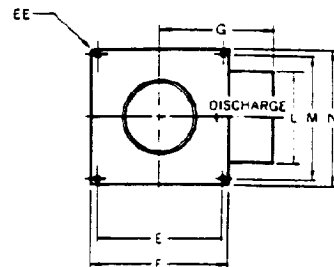
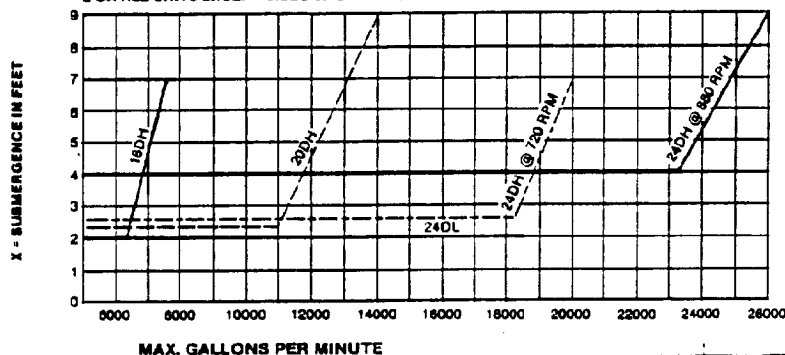
X = 0.33 K (in feet)

Y = Submergence (in feet)

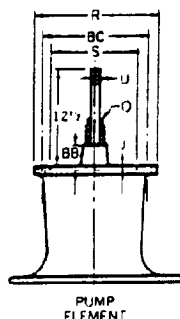
$$V = \frac{CFS}{(X + Y) (1.5 K)}$$

VERTICAL PROPELLER PUMP TYPE D DIMENSIONS

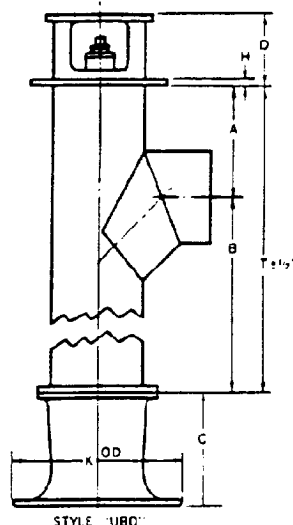
**FOR COLD WATER AT SEA LEVEL
MINIMUM SUBMERGENCE (DIMENSION "X") IS
2' ON ALL UNITS EXCEPT SIZES SHOWN BELOW**



THRUST FACTOR PER FOOT		
SIZE	"L"	"H"
8"	32	18
12"	40	24
18"	70	46
20"	125	78
24"	150	122

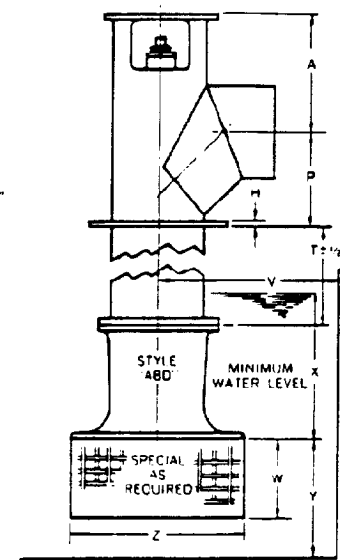


PUMP
ELEMENT



STYLE 'UBQ'

ABOVE BASE DISCHARGE - STYLE "ABD"
UNDER BASE DISCHARGE - STYLE "UBD"



PUMP SIZE	A MIN.	B MIN.	C	D	E	F	G	H	J	K	L	M	N	O BRQ. SIZE	P MIN.	Q	R	S	U	V MIN.	W	X	Y	Z	BC	BB	EE	PUMP SIZE
8	17½	10½	9%	14	20	22	11	1	3/16	12	8	20	22	1½	9	1½	10½	8½	1	12	4	2		12½	9½	2	½	8
8H	17½	10½	10%	14	20	22	11	1	3/16	12	8	20	22	1½	9	1	10½	8½	1	12	4	2		12½	9½	2	½	8H
12	20½	14	13%	16	24	26	16	1	¼	15½	12	24	26	2	13	1½	15	12½	1-3/16	16	6	2		16½	14	1	½	12
12H	20½	14	12%	16	24	26	16	1	¼	15½	12	24	26	2	13	1½	15	12½	1-3/16	15	6	2		16½	14	1	½	12H
16	22½	17	17%	16	30	32	21	1	¼	24	16	30	32	2	17	3	19%	16½	1-3/16	24	6	2		24½	18	1	½	16
16H	22½	17	18%	16	30	32	21	1	¼	23	16	30	32	2½	17	2%	19%	16½	1-7/16	23	6			24½	18	1	½	16H
20	28	21½	24	18	22	25	24	1	¼	34	20	42	44	2½	20	4	25	20%	1-11/16	34	10½			34½	23½	1	½	20
20H	28	21½	26	18	22	25	24	1	¼	35	20	42	44	3	20	3%	25	20%	1-11/16	35	10½			35½	23½	1	½	20H
24L	30	24	26%	18	36	42	28	1½	½	38	24	38	42	3	24	4½	27½	23%	1-15/16	38	12			38½	26	1	1	24L
24L	32	42(1)	26%	18	36	42	33	1½	½	38	30(1)	38	42	3	32	4½	27½	23%	1-15/16	38	12			38½	26	1	1	24L
24H	30	24	31½	18	38	42	28	1½(3)	½	40	24	38	42	3½	24	4	30	27	2-7/16	42	12			40½	28	1	1	24H
24H	32	42(2)	31½	18	38	42	33	1½(3)	½	40	30(2)	38	42	3½	32	4	30	27	2-7/16	42	12			40½	28½	1	1	24H

* Minimum dimension on ABD configuration only

(1) 30" pumps will have 20" column above discharge & 24" flange at top of bowl.

(2) 30" pumps will have 20" column above discharge & 26" flange at top of bowl.

(3) 1/4" male register.

NOTES:

Dimensions A, B, V and Y are min. A, B and P may be varied to suit application.

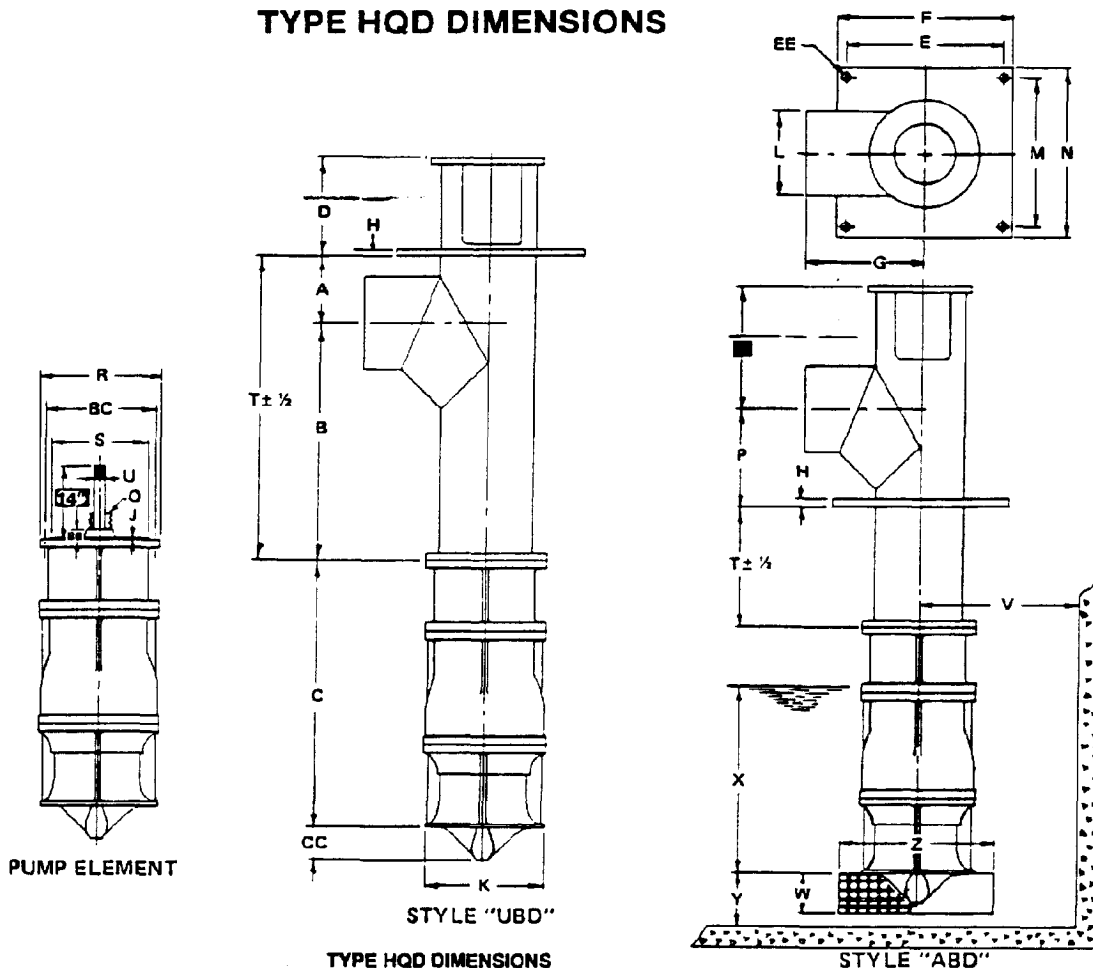
"Q" Dimension — while these units are not recommended for pumping solids, "Q" equals maximum size sphere which will pass through pump without clogging valve.





"O" in size of (C8P) bearing utilized in top case.

"Y" — For best results in sump positions, a minimum distance of $\frac{1}{4}$ to $\frac{1}{2}$ the bell diameter, "K" or at least $5 \times "K"$ (no less) should be maintained. A distance between "K" and $4 \times "K"$ is not recommended.



VERTICAL MIXED FLOW PUMP TYPE HQD DIMENSIONS



PUMP SIZE	COL. SIZE	A INCH	B INCH	C	D	E	F	G	H	J	K	L	M	N	O Bore Size	P INCH	Q	R	S	T INCH	U	V INCH	W	X	Y	Z	AG	BB	BE	CC
12"	12"	20%	14	38%	16	24	28	16		30	11%	12	24	28	3 1/4	13	1	11%	3	1 1/4	18	6	2		18	18	-4	1/2	N/A	
15"	12"	20%	14	40%	16	24	28	16	 MALE 1/2	13%	12	24	28	3 1/4	13	1 1/4	14%	12%	1 1/4	18	6	2 1/2		20	13%	+1	1/2	N/A		
17"	12"	20%	14	38	16	24	28	16	 MALE 1/2	15%	12	24	28	3 1/4	13	1 1/4	15%	13%	2 1/4	20	8	3		24	13%	-4	1/2	4"		
17"	16"	22%	17	44%	16	30	32	21	 MALE 1/2	15%	16	30	32	3 1/4	17	1 1/4	20	17	2 1/4	20	8	3		24	18%	-4	1/2	4"		
20"	16"	22%	17	45%	16	30	32	21	1 MALE 1/2	18%	16	30	32	4	17	2	20	17	2 1/4	24	10%	5		28	18%	+1	1/2	4 1/2"		
20"	20"	28	21%	45%	18	22	28	24	1% MALE 1/2	18%	20	42	44	4	20	2	23%	20	2 1/4	24	10%	5		28	22	+1	1/2	4 1/2"		
22"	20"	28	21%	51%	18	22	28	24	1% MALE 1/2	22%	20	42	44	4 1/4	20	2 1/4	23%	20	2 1/4	28	12	8		32	22	+4%	1/2	4 1/2"		
22"	24"	30	25	51%	20	38	42	28	1% MALE 1/2	22%	24	38	42	4 1/4	24	2 1/4	23%	20	2 1/4	28	12	8		32		+1	1	4 1/2"		
28"				58%					1%																				5 1/2"	

1. 30" Pump will have 20" Column above discharge and 24" Flange at top of Bowl.

2. 12HQR has 10" threaded Top Case—Bottom Column is threaded 10".

3. 12HQR has 10" threaded Bottom Case.

*Minimum dimension on ABC configuration only.

NOTES:

Dimensions A, B, V and Y are min. A, B and P may be varied to suit application.

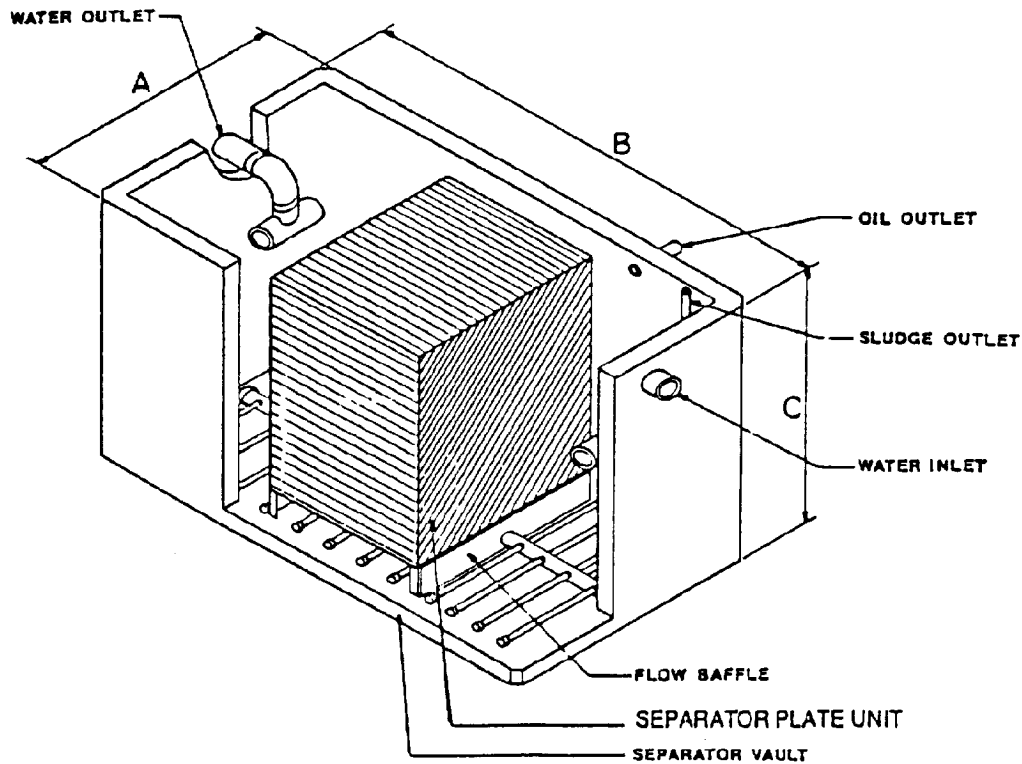
"Q" Dimension—while these units are not recommended for pumping solids, "Q" equals maximum size sphere which will pass through pump without clogging vanes.

"O" is size of (CBP) bearing utilized in top case.

"Y"—For best results in sump positions, a minimum distance of 1/4 to 1/2 the bell diameter, "K," or at least 5x "K" (no less) should be maintained. A distance between "K" and 4x "K" is not recommended.

FIGURE 4.6.5A SAMPLE COALESCING PLATE SEPARATOR

Detail from system manufactured by PIPE, Inc.



Sq. Ft. of Effective Separation Area	Capacity at 0.25 GPM/Sq. Ft.	Capacity at 0.50 GPM/Sq. Ft.	A	B	C	Inlet Size	Outlet Size	Oil Outlet Size	Sludge Outlet Size
33	8 GPM	16 GPM	27"	62 1/2"	30"	4"	4"	2"	2"
200	50 GPM	100 GPM	48"	72"	66"	4"	4"	2"	2"
300	75 GPM	150 GPM	56"	84"	72"	6"	6"	2"	2"
600	150 GPM	300 GPM	56"	84"	72"	8"	8"	3"	3"
1200	300 GPM	600 GPM	82"	154"	89"	10"	10"	3"	3"
2400	600 GPM	1200 GPM	92"	152"	98"	12"	12"	3"	3"
3200	800 GPM	1600 GPM	115"	187"	128"	15"	15"	4"	4"
4600	1150 GPM	2300 GPM	138"	186"	129"	18"	15"	4"	4"

1. Above capacities are based on 55° angle of inclination.
2. Larger Capacities available.

